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ABSTRACT

This course outline for industrial electronics, one of a series for teaching vocational industrial shop subjects in public schools, includes basic skills and technical information for the course. It should be supplemented with other complementary and necessary areas of related instruction. Fifteen major blocks, divided into 2 years of instruction, cover these topics: orientation, electrical physics, electrical units, electrical measurement, inductance and capacitance, AC power supply, transistors, amplification, oscillators, reception, transmission, circuitry and instrumentation, computer technology, optronics, and business of electronics. Each major block is comprised of two to six minor sections, each headed with a concise statement on task and aim. An outline of information and task detail, suggestions for teaching, and a list of references and aids are provided for each subsection. Appendixes include a bibliography containing references, vocational instructional services references, supplemental references, slides, films, and filmstrips; a suggested list of attitudinal objectives; and information on teaching methods. (YLB)

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A
SUGGESTED BASIC COURSE OUTLINE
FOR

INDUSTRIAL ELECTRONICS

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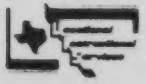

VOCATIONAL INSTRUCTIONAL SERVICES
VOCATIONAL INDUSTRIAL EDUCATION
TEXAS A&M UNIVERSITY
F. E. BOX 182, COLLEGE STATION, TEXAS 77843

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FOREWORD

This course outline is one of a series of basic course outlines for teaching vocational industrial shop subjects in public schools. Each course was developed by an outstanding vocational industrial teacher from his or her occupational field and reviewed by a select group of vocational industrial teachers. The development of each basic course outline was under the supervision of Vocational Industrial Education staff, Vocational Instructional Services, Texas A&M University and in cooperation with the Texas Education Agency.

The purpose of this basic course outline:

1. To assist the beginning teacher in selecting the occupational skills and related and technical information and provide a basis upon which the teacher can progressively build a functional course of study in accordance with the training needs of the students and the local community.
2. To assist the teacher in identifying and correlating pertinent technical information.
3. To assist the teacher in determining the time needed to teach each lesson and a basis for the proration of time in the total program.
4. To assist the teacher in the selection of appropriate methods, teaching aids, and references, and supply the teacher with the sources of information, films, references, and aids.
5. To assist the teacher in the development of/or selection of appropriate instructional sheets or materials.
6. To assist in the improvement of communications between the teacher and the student through the use of stated behavorial objectives (Aims) for each task and to corresponding technical information.
7. To provide interested educational and industrial groups and individuals with information regarding the scope, content, methods and techniques of trade preparatory instruction.
8. To provide local school administrators and boards of education with information that may assist them in selecting and inaugurating trade preparatory programs best suited to the needs of their student bodies.

This outline includes only the basic skills and technical information to be taught and should be supplemented with the other complementary and necessary areas of related instruction. Experiences should be provided for the development of desirable attitudes and appreciations.

PURPOSE

The purpose of vocational industrial education is to develop basic manipulative skills, safety judgments, proper work habits, desirable attitudes and appreciations for the purpose of fitting young persons for initial employment in industrial occupations and of upgrading or retraining workers employed in industry.

Training is provided through practical shop and/or laboratory experiences and other closely related school activities. The local school provides the shops or laboratories, tools, equipment and materials which are comparable to those used in industry. Each student enrolled receives three hours of instruction each day which is centered around the performance of useful or productive jobs and activities and taught by a teacher who is experienced and competent in the occupation.

COURSE OBJECTIVES

This outline is designed with the intention of providing students with an opportunity to develop skills, knowledge, attitudes and leadership after having the instruction provided by a competent electronics instructor.

The students will be able to:

1. Perform the basic manipulative skills involved in the occupation.
2. Make application and use of the underlying theories, technical information, and related occupational information to assure sound judgments, decisions and proper procedures involved in the occupation.
3. Appreciate and respect the employer-employee relationship, and have an awareness of the necessity of delivering worthy service for value received.
4. Develop a sense of personal integrity and confidence in their ability to earn their rightful place in the community.
5. Practice those qualities of citizenship which will lead the way toward a happy and productive life.
6. Gain employment in the occupation for which training was given.

ELECTRONICS MECHANIC

JOB DESCRIPTION

Repairs electronic equipment, such as computers, industrial controls, radar systems, telemetering and missile control systems, transmitters, antennas, and servomechanisms, following blueprints and manufacturers' specifications, and using handtools and test instruments. Tests faulty equipment and applies knowledge of functional operation of electronic units and systems to diagnose cause of malfunction. Tests electronic components and circuits to locate defects using instruments, such as oscilloscopes, signal generators, ammeters, and voltmeters. Replaces defective components and wiring and adjusts mechanical parts using handtools and soldering iron. Aligns, adjusts, and calibrates equipment according to specification. Calibrates testing instruments. Maintains records of repairs, calibrations, and testing. May install equipment in industrial or military establishments and in aircraft and missiles. May operate equipment, such as communication equipment, and missile control systems in ground and flight tests and be required to hold license from governmental agency. May be designated according to type of equipment repaired as Electronics Mechanic, Computer, Radar Mechanic.

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MAJOR BLOCK I ORIENTATION	TASK: Introduction to Pre-vocational Class AIM: The students will be able to describe operating procedures of the electronics classroom and lab, the skills and competencies they will learn, and some of the opportunities available to them upon completion of the course.		
MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Course Overview	Related Knowledge		
	I. Introduction		
	A. Instructor's name and background	Use chalkboard	
	B. Student introductions		
	II. Course description		
	A. Methods of instruction		
	B. Course objectives	Prepared passout of course content and objectives	Teacher prepared
	C. Scope and content		
	1. First year		
	2. Second year		
	D. Testing procedures	Show examples	State/local school policies
	1. Classroom		
	2. Laboratory		
	E. Grading system	Illustrate on chalkboard	
	F. Requirements		
	G. Credits and certificates		
	III. Laboratory activities		
	A. Tool and equipment storage	Tour storage area	
	B. Responsibilities		
	C. Check-out procedures	Discussion	
	D. Care and cautions		
	E. Use of equipment		
	F. Safety hazards	Question-answer session	Safety posters
	G. Job procedures		
	H. Housekeeping		
	1. Responsibilities		
	2. Special assignments		

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Course Overview (continued)	Related Knowledge (con't.) IV. Job opportunities A. Electrical B. Automotive C. Solid-state electronics D. Communication E. Digital electronics F. Research G. Self employment	Oral review Test	

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MAJOR BLOCK I ORIENTATION	TASK: Develop Safety Consciousness AIM: The student will describe unsafe conditions and actions in the work area and define the hazards peculiar to electrical work.		
MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Safety	Related Knowledge I. Safety awareness A. Accident causes B. Kinds of accidents C. Safety program	Prepare students Show slide presentation Read and discuss script during presentation Test on slide presentation	Slides and Script: Accident Causes, Slide presentation programmed for group instruction. Bureau of Occupational Safety - 3-224, U.S. Dept. of Labor, Washington, D.C. 20210 Free. Borrower pays return postage. Book two months in advance.
	II. Hand tools A. Tool selection B. Proper use C. Care and storage		
	III. Fire safety A. Types of fires B. Causes of fires C. Extinguishers 1. Types 2. Location 3. Proper use D. Building exits E. Fire drill procedures	Explain fire drill procedure Oral quiz	Student Workbook: VIS Ref. A, Safety for the Industrial Student, Self-contained safety workbook with 12 lessons on safety, and release forms. Available from address at front of this publication.
	IV. Conduct A. Grooming and dress B. Horseplay C. Safety check procedure D. Hazard reporting		
	21		22

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Safety (continued)	Related Knowledge (con't.) V. Electrical A. Grounding 1. Tools and equipment 2. Work tables 3. Wet floors B. Extension cords 1. Inspection and care 2. Proper use C. Overloads D. Conductor/insulator E. Unsafe acts F. Rescue procedures G. First-aid VI. Miscellaneous A. Machine operation B. Lifting C. Eye and ear protection D. Volatile materials E. Safety inspection	Teacher prepared safety test	

MAJOR BLOCK I ORIENTATION	TASK: Become Familiar With School/Shop Policies and Procedures AIM: The student will be able to participate in classroom and shop activities within the framework of school and shop regulations.		
MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Rules and Regulations	Related Knowledge		
	I. School policies	Passout: Rules and Regulations	Local school handbook for students
	A. Scheduling	Discuss with students	
	B. Attendance/tardies	Answer questions	
	C. Conduct and dress		
	D. Special activities		
	E. Grades and credits		
	II. Shop policies		
	A. Classroom procedures	Passout: List of rules	
	1. Textbooks	Discuss	
	2. Trade magazines		
	3. Assignments		
	4. Notebooks and workbooks		
	5. Tests		
	B. Laboratory	Tour lab facilities	
	1. Committees		
	2. Work stations		
	3. Duty assignments		VIS Ref. A,
	4. Horseplay		Sample forms in Safety
	5. Lockers	Private physician card	for the Industrial Student
	6. Release forms	Parental permission forms	
	C. Tools and meters		
	1. Checking in and out		
	2. Maintenance		
	3. Permission to use		
	III. Outside activities		
	1. Field trips		
	2. VICA		
	3. Fund raising		

MAJOR BLOCK I ORIENTATION	TASK: 1. Identify the Place of VICA in the Structure of Vocational Education AIM: The student will be able to identify VICA as an integral part of vocational education and to recognize the leadership opportunities inherent to the organization.		
MINOR BLOCK D	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
VICA	Related Knowledge		
	I. Background of the organization: Vocational Industrial Clubs of America	Explain, briefly, the factors that led to the creation of VIC (later VICA)	VIS Ref. B, VICA Handbook, Vocational Industrial Clubs of America, Inc., 105 N. Virginia Ave., Falls Church, Virginia 22046
		Explain the organization's place in vocational industrial education	
		Present certain statistics on membership growth, increase in number of chapter, transition from state to national organization	
	II. Organization of VICA	Show slides: Tell students what to look for in presentation Show slide presentation Discuss presentation	Slides: VICA, Developing Leaders for Tomorrow's Industry, Vocational Instructional Services, F. E. Box 182, Texas A&M University, College Station, Texas 77843
		Explain organization aspects: local chapter, district, state and national affiliations	Sup. Ref. B, pp. 117-125
		Outline administrative structure: local advisor, superintendent, area supervisor, state executive secretary, and national executive secretary	

MAJOR BLOCK I ORIENTATION	TASK: 2. Local Club Organization AIM: The students will know the structure, functions and goals of the local VICA organization and will be given the opportunity to participate as an officer, chairperson or assisting member.		
MINOR BLOCK D	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
VICA	Related Knowledge I. Membership drive A. Student awareness B. Collection of dues C. Organization report D. Initiation ceremony	Display of VICA posters and signs	Student - Teacher prepared VICA signs VIS Ref. E, VICA Initiation Ritual, Vocational Instructional Services, F. E. Box 182, Texas A&M University, College Station, TX 77843
	II. Election of officers A. Duties of officers B. Qualifications C. Nomination of candidates D. Voting E. Installation of officers	Explain duties and responsibilities Explain procedures for nomination of officers Explain and review installation of officers	VIS Ref. B, pp. 86-93 Teacher prepared: nomination forms, voting ballots, information sheet on qualifications
	III. Planning program A. Meetings 1. Business 2. Social meetings 3. Dates B. Social activities 1. Family banquet 2. Dances C. Service activities D. Competitive activities 1. Local 2. Area 3. State E. Public relations	Discuss plans for year Set up meetings Set up committees	VIS Ref. F, Official Officer Installation, Vocational Instructional Services, F. E. Box 182, Texas A&M University, College Station, TX 77843 Teacher - Student prepared listing of possible club activities

MAJOR BLOCK I ORIENTATION	TASK: 3. Parliamentary Procedure AIM: The student will obtain a basic knowledge of parliamentary practices through a comprehensive study of the basic rules of parliamentary procedure and by applying that knowledge through participation in an active club.		
MINOR BLOCK D	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
VICA	Related Knowledge		
	I. Importance of parliamentary procedure A. Local club B. Civic organization C. Business firms	Assigned reading Assignment as pertains to rule (chapter's)	VIS Ref. G, Parliamentary Guide for Vocational Industrial Clubs of America, Gray Jarrell D., Vocational Instructional Services, F.E. Box 182, College Station, TX 77843
	II. Application of parliamentary procedure A. Conduct business B. Competition	Discuss importance of having organized controlled meetings	VIS Ref. H, Parliamentary Procedure Workbook, Vocational Instructional Services, F.E. Box 182, College Station, TX 77843
		Show filmstrip Tell students what to look for in filmstrip Discuss filmstrip Test over filmstrip	Filmstrip: Parliamentary Procedure in Action, parts I, II, III, Educational Film Strips, Box 289, Huntsville, TX 77340
		Guest speaker	Guest speaker: Professional parliamentarian who is obtained by city government to preside at meetings
	Task Detail		
	Gain knowledge and skill through a study of the basic rules; practice the application of the rules in an active situation; and participate in competition on area, state, and national level	Assign each chapter to be covered Explain and discuss chapter Ask questions pertaining to chapter Assign practice problem for students Review Test	

MINOR BLOCK D	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
VICA (continued)	Related Knowledge (con't.)		
		Transparency on organizational structure of VICA organization	Transparency: Teacher prepared
	III. Opportunities for developing leadership abilities A. Serving as officer of local, area, or state chapter B. Attend leadership training conferences at area, state, or national level	Leadership skills learned while: (a) Serving as chairperson of committee, or committees (b) Serving on other committees Guest speaker	VIS Ref. B, pp. 100-105 Guest speaker: Former VICA student; district officer; or second year VICA student from another club or own club
	IV. Participate in local chapter activities A. Competitive activities B. Social activities C. Service activities D. Open house for public school week E. Parents night F. Initiation banquet G. Assembly program	Explain and discuss chapter activities with students Plan year's activities Show slides of previous year's activities	Slides or photo of previous club activities Suggested plan for year's activities VIS Ref. C, Texas and National VICA Competitive Activities Guide, Vocational Instructional Services, F.E. Box 182, Texas A&M University, College Station, TX 77843, 1975
	V. Participate in area meeting and state convention A. Chapter events B. Speed-skill contest C. Technical information D. Student selected jobs E. Individual events	Explain and discuss areas of competition at area and state level Discuss students' preparation for the events Refer to previous winners	VIS Ref. D, VICA U.S. Skill Olympics Regulations, Vocational Industrial Clubs of America Inc., 105 N. Virginia Avenue, Falls Church, Virginia 22046

MINOR BLOCK D	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
VICA (continued)	Task Detail		
	1. Nomination of officer candidates	Review qualifications of officers elect	Nomination forms
	2. Election of officers		Election ballots
	3. Installation of officers	Review duties and responsibilities	
	4. Students design VICA posters	Review election procedures	
	5. Collection of dues	Review and rehearse installation procedure	
	6. Initiation day and ceremony	Assignment on installation ceremony	
	7. Plan program	Review school policy on hanging posters and types of posters	
		Review proceedings for initiation ceremony	

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MAJOR BLOCK I ORIENTATION	TASK: Become Familiar With Tools and Electronic Parts AIM: The student will be able to select and safely use simple tools and equipment and to remove and classify assorted electronic parts for stock.		
MINOR BLOCK E	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Lab and Shop Activities	Related Knowledge		
	I. Class organization		
	A. Personal opportunities	Explanation	
	B. Responsibilities	List on chalkboard	
	C. Procedure for appointment	Oral questions	
	D. Official duties and reports	Discussion	
	II. Laboratory activities		
	A. Storage procedure		
	B. Check-out system		
	C. Responsibility for equipment		
	D. Care and cautions		
	E. Returning equipment		
	III. Shop activities		
	A. Operation hazards		
	B. Work experience		
	1. Equipment storage	Tour storage area	
	2. Parts requisitioning	Teacher prepared passout	
	3. Simple job procedures		
	4. Use of basic equipment	Demonstration	
	IV. Housekeeping		
	A. Responsibilities		
	B. Specific assignments		
	C. Industrial procedures		

MINOR BLOCK E	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Lab and Shop Activities (continued)	Task Detail 1. Obtain necessary tools 2. Remove parts from surplus chassis a. Vise b. Soldering iron c. Gas pliers d. Diagonal pliers e. Needle-nose pliers f. Flat wrenches g. Socket wrenches h. Screw drivers 3. Clean parts of excess solder 4. Straighten leads 5. Classify parts a. Resistors b. Capacitors c. R-F coils d. Radio transformer e. Power transformer f. Filter choke 6. Record nomenclature and quantity 7. Place in stock 8. Return tools and equipment 9. Clean up laboratory and shop area	Demonstration using: Soldering iron, assorted pliers, assorted screw drivers, wrench sets, Ohmmeter, VOM or VTVM Assorted chassis for disassembly Discussion Task assignment Practice on task Oral questions Performance test	

MAJOR BLOCK II ELECTRICAL PHYSICS	TASK: Investigate the Structure of Matter AIM: The student will be able to determine relative conductivity of materials and select materials for specific uses.		
MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Properties of Matter and Electricity	Related Knowledge I. Nature of matter II. Compounds, molecules, atoms III. Structure of atoms A. Nucleus B. Shells C. Charges IV. Physical properties A. Helium B. Hydrogen C. Carbon D. Copper V. Law of electrostatics VI. Electricity by friction VII. Repulsion and attraction VIII. Electron theory	Reading assignment Illustrate on chalkboard Discussion Oral questions Test	Ref. # 4, De Guilmo, Joseph M., Electricity/ Electronics Principles and Applications, Delmar Publishers Inc., Albany, New York 12205, 1982
	Task Detail 1. Observation of electrical changes a. Suspend balloons by threads b. Rub glass or plastic rod with silk or wool c. Electrify one balloon d. Repeat procedure with another balloon	Perform the following experiments	Use: Assorted colors of balloons, glass, plastic, rubber rods, strips of plastic sheet, wool, cloth silk, nylon cloth and thread

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Properties of Matter and Electricity (continued)	Task Detail (con't.) e. Bring balloons close and observe repulsion f. Experiment with different colors, some may not electrify g. Experiment with other cloth and materials h. Note which causes attraction and which causes repulsion	Task assignment Practice on task Questions Performance test	

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MAJOR BLOCK II ELECTRICAL PHYSICS	TASK: Determine Relative Conductance AIM: The student will be able to determine conductance of various substances and select materials for specific uses.		
MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Current Flow	Related Knowledge I. Electrostatic field II. Unit coulomb III. Electrical discharge IV. Free electrons V. Current and voltage VI. Insulators and conductors VII. Relative conductivity	Illustrate on chalkboard Reading assignment Transparencies	Ref. #1, Angerbauer, George, Principles of DC and AC Circuits, Breton Publishers, North Scituate, Massachusettes, 1987
	Task Detail 1. Connect bulb and battery with copper wire. Note glow 2. Connect as before using nichrome wire and note glow	Demonstrate and explain	1½ volt cell #112 (1.2 v.) flashlight bulb with socket Various sizes copper wire Nichrome wire

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Current Flow (continued)	Task Detail (con't.) 3. Use samples of other wire and note 4. Substitute distilled water circuit 5. Add salt to water and note glow	Review Test	Other wire as available Distilled water and salt

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MAJOR BLOCK II ELECTRICAL PHYSICS	TASK: Develop Understanding of Magnetism by Constructing Projects AIM: The student will be able to utilize magnetic properties of substances in designing and making elementary applications.		
MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Magnetism	Related Knowledge		
	I. Natural magnets II. Artificial magnets III. Magnetic poles A. Geographic B. Magnetite C. Magnetized D. Battery IV. Magnetic fields A. Bar magnet B. Horseshoe magnet C. Circular magnet D. Coil V. Induced magnetism A. Permanent B. Temporary	Demonstrate magnetic properties and poles Reading assignment Discussion Review Test	Magnetite (loadstone) Magnetized objects Ref. #3, Crozier, Patrick, Introduction to Electronics, Breton Publishers, North Scituate, Massachusettes, 1983
	Task Detail		
	1. Plot magnetic field of bar magnet a. Remove wrist watch b. Place magnet flat on table c. Lay stiff white paper on magnet d. Sprinkle iron filings on paper e. Tap paper lightly f. Record magnetic field 2. Repeat with other magnets 3. Compare results	Demonstration	Various shaped magnets Paper, iron filings Needle, saucer, wax paper

MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Magnetism (continued)	Task Detail (con't.) 4. Make floating needle compass a. Fill saucer 1/2 full of water b. Stroke each end of needle on opposite ends of magnet c. Place needle on 2" square waxed paper d. Place gently on water e. Observe compass action		

MAJOR BLOCK II ELECTRICAL PHYSICS	TASK: Construct Experimental Electromagnet AIM: The student will be able to design and construct electromagnetic devices and explain their industrial applications.		
MINOR BLOCK D	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Electromagnetism	Related Knowledge		
	I. Electromagnetic effects A. Magnetic field around conductor B. Magnetic field direction C. Magnetic field around loop of wire D. Magnetic field around coil II. Field strength A. Lines of force B. Permeability C. Residual magnetism III. Interaction of fields IV. Applications A. Telegraph B. Telephone C. Relay D. Solenoid E. Meters and instruments F. Crane magnet	Reading assignment Demonstrate and discuss magnetic effects Illustrate on chalkboard Summarize Review Test	Ref. #8, Loper, Ahr, and Clendenning, Introduction to Electricity and Electronics, Delmar Publishers, Albany, New York, 12205, 1979
	Task Detail		
	1. Construct electromagnet a. Cut paper to nail length b. Wrap paper around nail c. Wind wire snugly d. Fasten ends with tape e. Scrape ends of wire f. Connect to battery	Discuss and set up experiment	20 penny nail 1/8 lb. #23 insulated copper wire 1 1/2 - 6 volt source 6 volt stop light bulb Magnetic compass Iron filings Adhesive tape

MINOR BLOCK D	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Electromagnetism (continued)	Task Detail (con't.)		
	2. Test electromagnetic effects	Demonstrate	
	a. Pick up iron filings		
	b. Remove current		
	c. Observe some filings cling		
	d. Check polarity with compass		
	e. Reverse battery and recheck	Discuss results	
	f. Remove nail, connect, and dip	Task assignment	
	g. Note and record results	Performance test	

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MAJOR BLOCK II ELECTRICAL PHYSICS	TASK: Construct Primary Cell and Connect Solar Cell Devices AIM: The student will be able to describe the construction and use of primary cell batteries and to connect solar cells to charge batteries.		
MINOR BLOCK E	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Electrical Energy Sources	Related Knowledge		
	I. Static electricity	Demonstrate and explain	Ref. #7, Gerrish, Howard H., and Dugger, William E. Jr., Transistor Electronics, The Goodheart-Willcox Company, Inc., South Holland, Illinois, 1980
	A. Causes		
	B. Lightning		
	C. Hazards and safeguards	Summary	
	II. Primary cell		
	A. Various substances		
	B. Effects of chemicals	Demonstrate simple cell operation	Coins, vinegar, lemon
	C. Applications	Explanation	Sensitive D. C. meter
	D. Polarization		
	E. Advantages and disadvantages		
	III. Solar-cell theory	Explain and illustrate	Film: "Bell Solar Battery," Bell System Telephone Offices
	A. As a generating device	Show film and discuss	
	B. Multiple connections		
	C. Capacity	Oral questions	
	Task Detail		
	1. Dissect carbon-zinc cell	Demonstrate cell construction	
	a. Place in vise		
	b. Saw lengthwise		
	c. Use caution		
	d. Open carefully		
	e. Save zinc and carbon		
	2. Assemble primary cell	Demonstrate	Half-pint jar, weak solution sulfuric acid, water, 1 1/2 volt lamp
	a. Clean zinc and carbon		
	b. Fill jar half full with water		
	c. Caution: Do not allow acid on person, clothing, equipment		D. C. voltmeter
	d. Slowly add specified amount of acid		
	e. Place electrodes		

MINOR BLOCK E	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Electrical Energy Sources (continued)	Task Detail (con't.)		
	f. Wash hands		
	g. Measure voltage		
	h. Connect lamp	Summarize	
	i. Check voltage with load on cell	Oral questions	
	3. Connect solar cells in parallel	Demonstrate and discuss	Solar cell kit
	a. Measure open-circuit voltage	Task assignment	VTVM, VOM
	b. Apply normal load		Resistor assortment
	c. Measure and record	Practice	
	4. Connect cells in series and repeat steps above		
	5. Connect for battery charging and record results	Summarize Test	

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MAJOR BLOCK II ELECTRICAL PHYSICS	TASK: Construct Simple Generator AIM: The student will be able to utilize the principles of electro-mechanical source of electricity constructing a simple generator and recognize common faults.		
MINOR BLOCK E	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Electrical Energy Sources	Related Knowledge Electro-mechanical generator I. Mechanical construction II. Nomenclature of parts III. Principle of operation IV. Proper care V. Control devices	Exhibit disassembled unit List on chalkboard and pronounce Ask questions, invite discussion Test Discussion	Ref. #11, Miller, Rex, Industrial Electricity Revised, Bennett Publishing Co., Peoria, Illinois, 61615, 1978
	Task Detail Construct generator 1. Wind 2" coil of 10 turns 2. Connect to D.C. meter 3. Rotate in magnetic field 4. Note voltage output 5. Wind coil of 100 turns 6. Rotate in same field 7. Note voltage output 8. Note polarity reversal with direction changes	Review: Proper plane of rotation Polarity reversal Need for commutator Relative voltage output Left-hand rule for generators Demonstration	Permanent magnet Magnet wire Sensitive D.C. meter

MAJOR BLOCK II ELECTRICAL PHYSICS	TASK: Check Operation of Piezo-Electrical Crystal AIM: The student will be able to realize the fragile nature of crystal generators and check operational ability.		
MINOR BLOCK E	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Electrical Energy Sources	Related Knowledge		
	Piezo-electrical effect	Explanation	
	I. How voltage is produced	Illustration	
	II. Piezo-electrical substances		Sup. Ref. G, Singer, Phyllis and Blan Holden, Crystals and Crystal Growing, Doubleday, 501 Franklin Ave., Garden City, NY 11531, p. 105
	III. Uses	Oral questions	
	IV. Mechanical arrangement	Show film	
	A. Crystal phono-pickup	Discussion	
	B. Crystal microphone		Film: "Crystals, An Introduction", Bell Telephone System
	Task Detail		
	1. Measure output of phonopickup	Demonstration	VTVM or sensitive oscilloscope
	a. Connect to AC-VTVM or oscilloscope		Phono turntable with inexpensive crystal, monaural type
	b. Set on low scale		
	c. Start motor		
	d. Set on record		6 oz. Rochelle salts (drug store type)
	e. Study, read maximum		
	2. Grow crystal seeds	Discussion	Flat glass or ceramic container
	a. Stir Rochelle salts into 1/4 cup water until no more will dissolve	Task assignment Practice on task	6 oz. distilled water
	b. Pour saucer 1/2 full	Oral questions	Microscope
	c. Let dry out completely NOTE: do not touch	Performance test	
	d. View crystal under microscope and compare		

MAJOR BLOCK II ELECTRICAL PHYSICS	TASK: Connect a Photocell Alarm Device AIM: The student will be able to make use of photocell function in practical applications.		
MINOR BLOCK E	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Electrical Energy Sources	Related Knowledge		
	Photoelectric effect	Explanation	Ref. #7
	I. Types of cells	Reading assignment	
	II. Construction	Discussion	
	III. Uses	Oral questions	
		Test	
		Discussion	
	Task Detail		
	Set up intrusion alarm	Demonstration	Photo light meter
	1. Connect up relay		Photocell
	2. Connect bell to relay		Photo relay
	3. Shine light on photocell		Mirrors
	4. Darken room		Bell and battery
	5. Adjust until bell just turns off		Light source
	6. Add one mirror	Discuss results	
	7. Add second mirror	Summarize	
	8. Readjust relay if necessary	Oral questions	
	9. Final test	Performance test	

MAJOR BLOCK II

ELECTRICAL PHYSICS

TASK: Construct Thermocouple Device

AIM: The student will be able to make practical use of thermocouple principle.

MINOR BLOCK E	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Electrical Energy Sources	Related Knowledge		
	Thermocouples	Explanation with diagram	Ref. #7
	I. Principles of operation	Reading assignment	
	II. Types	Show operation	Millivolt generator
	III. Uses		Multimeter
	IV. Testing thermocouples		50 millivolt meter
			Heat source
		Oral questions	
		Test	
	Task Detail		
	Construct thermocouple	Demonstrate	Iron wire
	I. Select proper materials		Copper wire
	2. Twist ends tightly		0-50 micrometer
	3. Connect to meter		Heat source
	4. Heat twisted end	Discussion	
	5. Read meter	Task assignment	
	6. Check polarity	Practice on task	
	7. Connect several thermocouples in circuit	Performance test	
	8. Heat simultaneously		
	9. Read meter	Review of Block II	
		Examination on Block II	

MAJOR BLOCK III ELECTRICAL UNITS	TASK: Measure DC Voltage AIM: The student will be able to understand the meaning of voltage and polarity and will be able to properly connect voltmeter and read scale.		
MINOR BLOCK A	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Volts and Polarity	Related Knowledge		
	I. Meaning of potential	Definition on chalkboard	Ref. #6, Gerrish and Dugger, Electricity and Electronics, The Goodheart-Willcox, Co., Inc., South Holland, Illinois, 1980 Transparencies
	II. Significance of "potential-difference"	Ask questions Definition on chalkboard	
	III. Net effect of "equal potential"		
	IV. Electron direction	Explain and discuss	
	A. Early concept		
	B. Actual direction		
	C. Confusing result		
	D. Modern convention		
	V. Units of measure		
	A. Microvolt		
	B. Millivolt		
	C. Volt		
	D. Kilovolt		
	VI. Meter scales		
	A. Proper selection		
	B. Reading techniques		
	VII. Meter sensivity		
	A. Meaning		
	B. Mathematics		
	C. Effect on circuit		
	Task Detail		
	1. Measure voltage	Demonstration	VOM or VTVM 4 dry cell, assorted sizes
	a. Set meter to proper range		
	b. Connect negative lead to negative of circuit	Discussion	
	c. Connect positive lead to positive of circuit	Task assignment	
	d. Read voltage on scale for which meter is set	Practice on task	

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Volts and Polarity (continued)	Task Detail (con't.) e. Read readings of all four cells and compare f. Connect cells (1) 2 in series (2) 2 in parallel (3) 4 in series (4) 4 in parallel g. Measure voltage on each of above and record 2. Make comparison of connections and resulting voltage	Oral questions Performance test	

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MAJOR BLOCK III ELECTRICAL UNITS	TASK: Determine Current Flow Through Given Load AIM: The student will be able to properly connect an ammeter to determine current flowing in a given load.		
MINOR BLOCK B	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Amperes and Electron Flow	Related Knowledge		
	I. The quantity "coulomb"	Definition on chalkboard	Ref. #12, Oliva and Dale, Basic Electricity and DC Circuits, Texas Instruments Learning Center, Dallas, Texas, 1979
	II. Meaning of "Ampere"	Examples and explanation	
	III. Relation to electron flow	List on chalkboard	
	IV. Use of proper terms	Explanation, work sample problems	
	A. Microampere		
	B. Millampere	Students work conversion problems	
	C. Ampere		
	D. Kiloampere	Ask and invite questions	
	V. Use of "powers of ten"	Test	
	VI. Effect of controlling voltage	Discussion and summary	
	VII. Effect of resistance in circuit		
	Task Detail		
	1. Connect ammeter	Demonstration	Multimeter
	2. Apply power(gradually if possible)		Variable power source
	3. Read current and record		Resistor assortment
	4. Vary voltage in steps and record	Discussion of results	
	5. Construct graph of results	Task assignment	
	6. Vary resistance loads and record	Practice on task	
	7. Construct graph of results	Oral questions	
		Performance test	

MAJOR BLOCK III ELECTRICAL UNITS	TASK: Select Resistors By Color Code AIM: The student will be able to recognize resistance values and tolerance factors by color code.		
MINOR BLOCK C	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Ohms and Resistance	Related Knowledge		
	I. The "standard ohm"	Explanation of definition	Ref. * 12
	II. Resistance variables	Reading assignment	
	A. Material	Mathematics assignment	
	B. Size	Illustrations	
	C. Length	Examples	
	D. Temperature		
	III. Use of tables and charts		
	A. Ohm		
	B. Kilohm		
	C. Megohm		
	IV. Resistor color code	Oral questions	
	V. Wattage of resistors	Test	
		Discussion	
	Task Detail		
	1. Assort resistors into groups by 3rd color	Demonstration using	Assortment of color-coded resistors
	2. Divide groups into sub-groups by 2nd color	Discussion	Ohmmeter
	3. Re-divide by first color	Task assignment	
	4. Arrange in ascending order	Practice on task	
	5. Record all values	Performance test	
	6. Indicate percent tolerance of each		
	7. Indicate wattage of each		

MAJOR BLOCK III ELECTRICAL UNITS	TASK: Ohm's Law Calculations AIM: The student will be able to perform various forms of Ohm's Law calculations relating to Volts, Amperes, and Ohms.		
MINOR BLOCK D	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Simple Ohm's Law	Related Knowledge		
	I. Formula variations for:	Illustrate mathematical definition	Ref. # 12
	A. Supply voltage	Chalkboard diagrams	
	B. Circuit current	Illustrate algebraic variations	
	C. Circuit resistance	Show derivations	
	II. Simple circuit diagrams	Show physical proof of each	
	III. Schematics and symbols	Illustrate sample problems	
	IV. Powers of ten	Chalkboard presentations by individual students	
	A. Adding		
	B. Subtracting		
	C. Dividing	Homework assignment	Teacher prepared assignment
		Oral questions	
		Test	
		Discussion	

MAJOR BLOCK III ELECTRICAL UNITS	TASK: Measure Power In Watts AIM: The student will be able to properly connect meters to determine apparent power and relate kilowatt-hours.		
MINOR BLOCK E	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Watts	Related Knowledge		
	I. Meaning of watt	Definition on chalkboard	Ref. #5, Fulton and Rawlins, Basic AC Circuits, Texas Instruments Learning Center, Dallas, Texas, 1981
	II. Variations of the unit	Discussion variation	
	A. Microwatt	Ask questions	
	B. Milliwatt	List commonly metered circuits on chalkboard	
	C. Watt		
	D. Kilowatt	Define KWH on chalkboard or overhead	Ref. #12
	E. Megawatt		
	III. Uses of power measurement	Explanation	
	IV. Meaning of kilowatt-hour	Calculations	
	V. Calculation of KWH	Reading assignment	
	VI. How to read KWH meter and calculate power bill	Drill on lesson	
		Oral questions	
		Test	
		Discussion	
	Task Detail		
	1. Connect in series circuit	Demonstration	AC ammeter, AC voltmeter
	a. Load		
	b. Ammeter	Discussion of task	Wattmeter
	c. Power source	Task assignment	Suitable loads, and AC power
	2. Connect voltmeter across load	Practice on task	
	3. Apply power and read meters	Review results	
	4. Calculate KWH if power applied for 100 hours	Oral questions	
	5. Calculate watts through load	Performance test	
	6. Verify with wattmeter		
	7. Repeat calculations for various loads		

MAJOR BLOCK III ELECTRICAL UNITS	TASK: Determine Power, Current, Voltage, Or Resistance AIM: The student will be able to calculate unknown variable in a DC circuit with any two of the four variables specified.		
MINOR BLOCK F	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Ohm's Law and Watt's Law	Related Knowledge I. Mathematical formula relating power, voltage, current, and resistance II. Solution of power problems using various formula	Explanation Discussion Solutions on chalkboard Student assignment Drill on lesson Student solutions on chalkboard Answer questions Test Discussion	Ref. #7
	Task Detail 1. Connect circuit consisting of knowns E and I 2. Read and record 3. Compute P and R 4. Connect circuit consisting of knowns E and P 5. Read and record 6. Compute I and R 7. Connect circuit consisting of knowns 8. Read and record 9. Compute E and R 10. Connect circuit consisting of knowns P and R 11. Read and record 12. Compute E and I	Demonstration Illustrations on chalkboard Discussion Task assignment Practice on task Review problem Review on Major Block III Examination on Major Block III	DC Source Assorted resistors Ammeter Voltmeter Wattmeter

MAJOR BLOCK IV ELECTRICAL MEASUREMENT	TASK: 1. Distinguish Series and Parallel Circuits AIM: The student will be able to describe advantages and disadvantages of series and parallel circuits.		
MINOR BLOCK A	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Circuits	Related Knowledge		
	I. Meaning of "series connected"	Illustrate on chalkboard	Ref. =1
	II. Meaning of "parallel connected"	Demonstrate	Light bulbs, 6 volt dry cell, wire, switches
	III. Advantages	Discussion	
	IV. Disadvantages		
	V. Wire		
	A. Gauge		
	B. Length		
	C. Material		
	D. Temperature		
	VI. Review Watt's Law	Summarize Oral quiz	

MAJOR BLOCK IV ELECTRICAL MEASUREMENT	TASK: 2. Distinguish Combination Circuit Characteristics AIM: The student will be able to describe voltages and currents in a combination circuit.		
MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Circuits	Related Knowledge I. Combination circuits II. Total resistance III. Equivalent resistance IV. Two or more power sources V. Voltage drop	Illustrate on chalkboard Demonstrate Discuss formulas Assign problems Review	Ref. = 12

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MAJOR BLOCK IV

ELECTRICAL MEASUREMENT

TASK: 1. Connect and Read Ammeter

AIM: The student will be able to recognize the hazards, properly connect an ammeter into a circuit, read and safely remove.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Meters	Related Knowledge		
	I. Operation of moving-coil meter	List on chalkboard	Ref. #6
	II. Function and use	Explanation and discussion	
	III. Limitations and hazards	Work and explain sample math problems	
	IV. Meter protection devices	Assign problems	
	V. Use of shunts	Student drill	
	VI. Mathematical relationships	Oral questions	
	A. Maximum current	Test	
	B. Average current	Discussion	
	C. Effective current		
	Task Detail		
	1. Connect ammeter	Demonstration of the task	
	a. Remove power from device	Discussion	
	b. Open circuit to be measured	Task assignment	
	c. Observe polarity	Practice on task	
	d. Connect ammeter	Oral questions	
	2. Read ammeter	Performance test	
	a. Set to highest usable scale		
	b. Turn power "on"		
	c. Observe reading		
	d. Record reading		
	3. Disconnect ammeter		
	a. Turn power "off"		
	b. Remove meter from circuit		

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MAJOR BLOCK IV ELECTRICAL MEASUREMENT	TASK: 2. Use Voltmeter AIM: The student will be able to select most suitable voltmeter, take readings, and interpolate scale readings.		
MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Meters	Related Knowledge		
	I. Function of voltmeter	Explanation	Ref. #6
	II. Principle of operation	Discussion	
	III. Meaning of ohms-per-volt	Examples worked on chalkboard	
	IV. Effect upon circuit	Illustrate on chalkboard	
	V. Interpolation	Transparencies or mock-up of meter	
	VI. AC and DC scales		
	Task Detail		
	1. Connect voltmeter	Demonstration	Operating equipment, as convenient and powered circuitry suitable for testing
	a. Set range		
	b. Select AC or DC		
	c. Select lead type	Closely supervised procedures	
	(1) Test prods	Questions before steps	
	(a) Select test point	Discuss problem areas	
	(b) Turn on power	Oral questions	
	(c) Set polarity switch	Performance test	
	(d) Contact chassis or lowest point of potential		
	(e) Contact "high" side of test		
	(f) Read meter		
	(g) Interpolate		
	(h) Record		

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Meters (continued)	Task Detail (con't.) 2. Disconnect voltmeter a. Test prod (1) Remove from circuit (2) Turn off power b. Alligator clips (1) Remove power (2) Remove clips 3. Store meter a. Remove leads b. Fold for storage c. Place in compartment		

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MAJOR BLOCK IV

ELECTRICAL MEASUREMENT

TASK: 3. Adjust Ohmmeter And Check Resistances

AIM: The student will be able to understand basic uses for the ohmmeter and will be able to check resistance values of resistors and other components.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Meters	Related Knowledge		
	I. Types of ohmmeter circuits A. Series B. Shunt II. Use of multipliers III. Voltage source differences IV. Circuits in common use	Illustration Explanation Reading assignment Drill Oral questions Test Discussion	Ref. # 4
	Task Detail		
	1. Check ohmmeter 2. Set to proper scale 3. Adjust "zero" setting 4. Connect to device 5. Read scale in use 6. Interpolate reading 7. Remove meter connections 8. Record results	Demonstration of task Discussion Task assignment Practice on task Oral questions Performance test	

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MAJOR BLOCK IV

ELECTRICAL MEASUREMENT

TASK: 4. Use Basic Multimeter

AIM: The student will be able to select proper scale, take readings, and identify electronic parts with multimeter.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Multimeter	Related Knowledge		
	I. Basic circuit knowledge	Illustration on chalkboard	Ref. # 4
	II. Connections and switches	Reading assignment	Ref. # 3
	III. Proper use of scales	Drill on lesson	
	IV. Accuracy available	Discussion circuitry of multimeter	
		Oral questions	
		Test	
		Discussion	
	Task Detail		
	1. Set selector switch to bolts or milliamperes	Demonstrate	Multimeter(VOM) and assorted parts for testing
	2. Plug leads into proper jacks	Discussion	
	3. Connect to circuit or parts	Task assignment	
	4. Take readings	Practice on task	
	5. Interpolate	Oral questions	
	6. Record readings	Performance test	
		Film:	Film: TF 11-1667, Circuit Testing With Meters and Multimeters --Practical Application, U.S. Army
		Tell students what to look for in film	
		Show film	
		Discuss film	
		Test on film	

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MAJOR BLOCK IV ELECTRICAL MEASUREMENT	TASK: 5. Use The VTVM-Type Multimeter AIM: The student will be able to set up and use low--drain type meter in operating circuits.		
MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Meters	Related Knowledge		
	I. Input circuitry	Explanation	Ref. # 3
	II. Loading factor	Illustration	
	III. Analyzing results	Reading assignment	
	IV. Comparison of VTVM and transistorized VOM	Drill on lesson	
		Discuss modifications	
		Oral questions	
		Test	
		Discussion	
	Task Detail		
	1. Turn VTVM (or transistorized VOM) on	Demonstration	VTVM(or Transistorized VOM)
	2. Allow warm-up time		Powered apparatus with resistance circuits
	3. Set to proper scale		
	4. Adjust to "Zero"		Standard VOM
	5. Power test circuit	Discussion	
	6. Make measurements	Ask questions	
	7. Record readings	Summarize	
	8. Make same tests with standard VOM	Performance test	
	9. Record readings		
	10. Make comparisons		

MAJOR BLOCK IV ELECTRICAL MEASUREMENT	TASK: 6. Set Up And Use The Oscilloscope AIM: The student will be able to make, set-up, and use the oscilloscope to make adjustments and simple measurements.		
MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Meters	Related Knowledge		
	I. Oscilloscope uses	List on chalkboard	Ref. # 5
	II. Block diagram	Illustrate on chalkboard	
	III. Advantages-disadvantages	List and discuss	
	IV. Function of coating	Explain	Breadboarded 2" CRT circuit
	V. Function of beam	Reading assignment	
	VI. Internal beam control	Drill on lesson	Signal source
	VII. External beam control	Oral questions	
		Test	
		Discussion	
	Task Detail		
	1. Apply power to oscilloscope	Demonstrate	Common oscilloscope
	2. Warm up five minutes		Audio amplifier or other apparatus to test signal source
	3. Turn sweep to "off"		
	4. Set VERT. AMP. to minimum		
	5. Center spot		
	6. Adjust INTENSITY		
	7. Adjust FOCUS		
	8. Set sweep		
	9. Contact point of test		
	10. Set VERTICAL AMP.		
	11. Adjust FREQUENCY		
	12. Observe and record		
	13. Remove leads	Review	
	14. Turn off all power	Examination	

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MAJOR BLOCK IV ELECTRICAL MEASUREMENT	TASK: 1. Connect And Measure Current Flow In Series And Parallel Circuits AIM: The student will be able to intelligently make practical use of series and parallel circuits.		
MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
DC Current Analysis	Related Knowledge		
	I. Meaning of "series connected"	Illustrate	Ref. # 12
	II. Meaning of "parallel connected"	Explanation, work mathematics examples	
	III. Results from DC sources:		
	A. Connected in series	Student assignment	
	B. Connected in parallel	Oral questions	
		Test	
		Discussion	
	Task Detail		
	1. Connect two known equal resistances in series	Demonstrate	Resistor assortment Miscellaneous resistive loads
	2. Measure and record		
	3. Reconnect in parallel	Discussion of task	Power source multimeter
	4. Measure, record	Task assignment	
	5. Compare with series connected	Practice on task	
	6. Repeat using four known resistors	Oral questions	
	7. Record conclusion	Performance test	
	8. Connect cells in series		
	9. Measure voltage and record		
	10. Connect cells in parallel		
	11. Measure voltage		
	12. Record conclusions		
	13. Connect old resistances in series		
	14. Record results		
	15. Connect old resistances in parallel		

MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Current Analysis (continued)	Task Detail (con't.) 16. Record observations 17. Solve mathematically and compare results		

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MAJOR BLOCK IV ELECTRICAL MEASUREMENT	TASK: 2. Analyze Circuits Using Kirchhoff's Laws AIM: The student will be able to analyze circuits and make practical application of Kirchoff's Laws.		
MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
DC Current Analysis	Related Knowledge I. Meaning of Kirchoff's law II. Application III. Advantages over Ohm's law IV. Problem solving	Explanation Illustration Discussion Student assignment Drill on lesson Oral questions Test Discussion	Ref. # 7
	Task Detail 1. Cause voltage division a. Connect resistors in a series b. Apply voltage and measure c. Record voltage drop across each resistor d. Add drops and compare with source voltage e. Record current through circuit f. Calculate E = IR of each resistor g. Compare these with measured voltage of each h. Repeat the above with second set of resistors i. Draw conclusions	Demonstration of task Exploration of charting procedure Assignment of task Practice on task Oral questions Performance test	

MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Current Analysis (continued)	Task Detail (con't.) 2. Prove current law a. Connect resistors in parallel b. Apply power c. Record total current d. Record current in each branch e. Add currents in branches and compare with total 3. Series-parallel applications a. Connect resistors in series-parallel b. Apply power to circuit c. Record total current d. Record current through each resistor e. Make observations	Review Examination	

MAJOR BLOCK V INDUCTANCE AND CAPACITANCE	TASK: 1. Determine Factors Of Self Inductance AIM: The student will be able to experimentally determine reactance, inductance, and impedance of a simple AC circuit.		
MINOR BLOCK A	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Inductance	Related Knowledge		
	I. Meaning of inductance II. Meaning of self-inductance III. The unit "Henry" IV. Factors affecting inductance V. Current-voltage relationship VI. Reactance of circuit VII. Impedance of circuit	Explanation Explain formula Work sample problems Show with oscilloscope Perform experiments Student assignment Drill on lesson Oral questions Practice on chalkboard Test Discussion	Ref. # 6
	Task Detail		
	1. Determine reactance of coil a. Connect coil, AC ammeter, AC source in series b. Connect AC voltmeter across source c. Apply AC power d. Record current flow and voltage e. By Ohm's Law(neglecting R of coil) $X_1 = \frac{E_1}{I}$ at the frequency used f. If adjustable frequency, double frequency and recalculate 2. Solve for (L) in Henry's a. Substitute results above into equation $X_1 = 2\pi FL$	Demonstration of experiments Student assignments Practice on assignment Oral questions Performance test	

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Inductance (continued)	Task Detail (con't.) 3. Determine reactance of circuit a. Add resistor in series with coil b. Repeat reactance step above to obtain reactance or resistive circuits at frequencies selected 4. Determine impedance of circuit (including resistance). Substitute reactance above into impedance equation ($Z-2\pi FL$) to obtain impedance at any frequency		

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MAJOR BLOCK V INDUCTANCE AND CAPACITANCE	TASK: 2. Prepare Transformer For Rewinding AIM: The student will be able to calculate and wind an adjustable laboratory transformer to specifications.		
MINOR BLOCK A	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Inductance	Related Knowledge		
	I. Meaning of "mutual inductance"	Show and explain	Ref. # 6
	II. Polarity of induced voltage	Exhibit cutaway or tear down a transformer	
	III. Construction features a power transformer	Design on chalkboard	
	IV. Transformer losses	Calculate for:	
	V. Calculations for design	100 - watt size core, 9-40 v. DC, 1 amp maximum	
	A. Power output	Reading assignment	
	B. Core size and type	Drill on lesson	
	C. Primary voltage	Oral questions	
	D. Voltage of secondaries	Test	
	E. Current in secondaries	Discussion	
	F. Turns ratios		
	Task Detail		
	1. Tear down old transformer	Demonstration of tear-down, step by step	
	a. Carefully remove case	Students follow steps	
	b. Carefully handle primary leads	Supervise closely	
	c. Remove core; piece at a time	Discussion of steps to here	
	d. Count filament turns removed and record	Task assignment	
	e. Calculate turns-per volt	Practice on task	
	f. Calculate turns needed	Oral questions	
		Performance test	

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Inductance (continued)	Task Detail (con't.) g. Calculate winding needed h. Remove high voltage winding i. Check primary for damage (1) Visually (2) Resistance (3) Odor j. Store for further use	Review Examination	

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MAJOR BLOCK V INDUCTANCE AND CAPACITANCE	TASK: 1. Identify And Test Capacitors AIM: The student will be able to select for use and test various capacitors.		
MINOR BLOCK B	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Capacitors	Related Knowledge		
	I. Physical characteristic	Display available types	Ref. # 12
	A. Electrical	Explanation of types	
	B. Visual	Show differences	
	II. Markings	List arrangements on chalkboard	
	A. Digital	Display charts or transparencies	
	B. Color code		
	Task Detail		
	1. Ohmmeter test	Demonstrate	Ohmmeter
	a. Set ohmmeter on high range	Discussion	Capacitor bridge
	b. Read resistance scale	Task assignment	
	c. Reverse leads, re-read (may be electrolytic)	Practice on task	
		Oral questions	
		Performance test	
	2. Capacitor bridge measurement		
	a. Connect capacitor in circuit	Film:	Film: TF 11-3627, Capacitance, Part I, Physical and Electrical Characteristics and Factors Affecting Capacitance, U.S. Army
	b. Set voltage switch	Tell students what to look for in film	
	c. Check for leakage	Show film	
	d. Set range selector	Discuss film	
	e. Balance bridge	Test on film	
	f. Read capacity		

MAJOR BLOCK V INDUCTANCE AND CAPACITANCE	TASK: 2. Construct And Analyze R-C Time-Constant Circuits AIM: The student will be able to design R-C time constant circuits to specifications.		
MINOR BLOCK B	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Capacitors	Related Knowledge		
	I. The unit Farad	Definition on chalkboard	Ref. # 12
	II. R-C time-constant	Explanation	
	III. Variables	Show mathematics, work examples on chalkboard	
	IV. D-C circuit reactions	Show using oscilloscope	
	V. Transient response	Show using ohmmeter	
	VI. Transient response	Show using AC ammeter	
	VII. Meaning of capacitive reactance	Definition of chalkboard Reading assignment	
	Task Detail		
	R-C time-constant	Demonstration	Assortment of resistors and capacitors, adjustable DC current source, knife switch, and VOM
	1. Connect 1 mfd. capacitor, 10 megohm resistor VOM, and current source, switch, in series		
	2. Set VOM to proper milliampere scale	Discussion Task assignment	
	3. Close switch, observe meter	Practice on task	
	4. Check time for meter to approximate zero	Oral questions Performance test	
	5. Calculate time constant		
	6. Vary components and recheck for time-constant		
	7. Compare with mathematical calculations of time-constants		

MAJOR BLOCK V INDUCTANCE AND CAPACITANCE	TASK: 3. Connect Capacitors For Special Applications AIM: The student will be able to properly calculate and combine capacitors in combination for special purposes.		
MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Capacitors	Related Knowledge		
	I. Capacitors in parallel A. Effective capacitance B. Voltage rating of combination	Illustrations on chalkboard Explanations Illustration, work examples on chalkboard	Ref. # 4
	II. Capacitors in series A. Effective capacitance B. Voltage rating of combinations	Explanation Student assignment Oral questions Drill on lesson Test Discussion	
	Task Detail		
	1. Connect meter and 10 mfd. capacitor in series 2. Contact 1 ½ V. cell terminals 3. Remove from cell and complete circuit	Demonstrate	115 V. AC source 1 ea. 15 watt bulb with socket 2 ea. 1 ½ volt cell 0-1 milliammeter
	4. Note results on meter 5. Connect 115V. AC source, .5 mfd. capacitor and 15 W. bulb in series 6. Add other .5 mfd. in series 7. Note brilliance of lamp 8. Change to parallel-connected capacitors 9. Note results	Explain and discuss Task assignment Practice task Oral questions Performance test	

MAJOR BLOCK V INDUCTANCE AND CAPACITANCE	TASK: 4. Identify And Check Capacitor Functions AIM: The student will be able to identify capacitor functions and make in-circuit checks with VOM.		
MINOR BLOCK B	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Capacitors	Related Knowledge		
	I. Capacitor functions in schematic diagrams II. Identification of capacitors in apparatus	Transparencies Explain and discuss simple schematic diagram of selected apparatus Relate diagram to apparatus Discussion questions Student assignment Drill on lesson Oral questions Test Review	Ref. # 4
	Task Detail		
	1. Place section under test in most convenient position	Demonstration	VOM
	2. Set VOM to Ohms	Discussion	
	3. Refer to diagram:	Task assignment	
	a. Locate capacitors connected to common "ground"	Practice on task Oral questions	
	b. Observe polarity where necessary and check capacitors for short circuit		
	c. Locate "grounded" capacitors and test for short circuit		
	d. Record results	Review Examination	

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MAJOR BLOCK VI
AC POWER SUPPLY

TASK: 1. Calculate And Test Transformer
AIM: The student will be able to make transformer calculations and to safely perform tests.

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Power Transformer	Related Knowledge		
	I. Current transformation	Discussion	Ref. # 3
	II. Resistance transformation	Questions	
	III. Reactance transformation		
	IV. Safety factors		
	V. Short-circuit test	Demonstration	
	VI. Computations		
	VII. Open-circuit test	Work problems on chalkboard	
	VIII. Voltage regulation		

MAJOR BLOCK VI AC POWER SUPPLY	TASK: 2. Wind Transformer For Power Supply AIM: The student will be able to determine requirements and wind transformer to specifications.		
MINOR BLOCK A	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Power Transformer	Related Knowledge		
	I. Electrical characteristics	Display transformer types	Ref. # 3
	II. EIA color coding	List coding on chalkboard	
	III. Magnetic-core properties	Review applicable theory	
	IV. Turns-per-volt	Explain mathematics and confirm with meter measurements	
	V. Wire size requirements	Refer to chart	
		Calculate samples on chalkboard	
		Student assignment	
		Student presentation	
		Oral questions	
		Test	
		Discussion	
	Task Detail		
	1. Prepare primary for new secondaries	Demonstration	75-150 watt transformer Necessary magnet wire
	a. Cut insulating paper to width(use stiff, strong paper)		Insulating paper Insulating varnish
	b. Glue first layer		VOM
	c. Tightly add two more layers or less than 1/16 inch and glue	Discussion	Resistor load
		Task assignment	
	d. Keep smooth and level	Practice on task	
	2. Wind new secondary	Oral questions	
	a. Select proper size wire	Performance test	
	b. Wind off sufficient wire		
	c. Stretch wire until straight		
	d. Select side and end for leads		
	e. Allow 6-inch lead at beginning		
	f. Fasten first turn		

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Power Transformer (continued)	Task Detail (con't.) g. Wind even and tight h. At each top bring out loop i. If ample window, put paper between layers j. Wind only the amount that will easily fit into window k. Fasten last turn l. Add more paper m. Soak in insulating varnish n. Air-dry or bake as required 3. Reassemble a. Reassemble, tighten screws b. Inspect leads for grounding c. Mount on chassis d. Connect to voltage changing switch 4. Testing procedure a. Ohmmeter test for ground b. Ohmmeter test for short c. Resistance tests d. Apply power e. Check for heating f. Measure open circuit voltage g. Connect designed load h. Measure loaded voltage i. Measure load current j. Calculate watts to load k. Measure primary watts l. Determine watts input m. Calculate efficiency		

MAJOR BLOCK VI AC POWER SUPPLY	TASK: 1. Connect Rectifier AIM: The student will be able to analyze rectifier requirements to determine proper rectifier and to properly install rectifier.		
MINOR BLOCK B	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Power Supply Components	Related Knowledge		
	I. Principles of rectification	Illustration on chalkboard	Ref. = 3
	II. Types of rectifiers	Explanation	
	III. Common rectifier circuits	Display	
	A. Half-wave	Explain operation	
	B. Full-wave	Student assignment	
	C. Bridge	Explain with chalkboard illustrations	
	D. Doubler		
	E. Tripler	Drill on lesson	
	F. Quadrupler		
	Task Detail		
	1. Select type of rectifier unit	Demonstration of task	Assortment of rectifier units
	2. Determine cathode and anode terminals		Transformer previously rewound
	3. Determine polarity from schematic		Suitable load resistor
	4. Install rectifier for proper polarity		VOM
	5. Apply power to transformer	Discussion Task assignment	
	6. Test output	Practice on task	
	7. Record results	Oral questions Performance test	

MAJOR BLOCK VI
AC POWER SUPPLY

TASK: 2. Install Filter
AIM: The student will be able to select units, assemble, install and evaluate filter performance.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Power Supply Components	Related Knowledge		
	I. Types of filter circuits		Ref. = 3
	II. Characteristics of various types	Explain and discuss Examples on chalkboard	
	III. Evaluation requirements		
	IV. Use of charts and nomographs	Invite and answer questions Student assignment Oral questions Test Discussion	
	Task Detail		
	1. Determine requirements	Demonstration	Assorted filter components
	2. Select proper filter components		Power supply load resistors
	3. Install as per circuit		VOM
	4. Test without power		Oscilloscope
	5. Check voltage output with various loads	Discussion	Graph paper
	6. Monitor waveform	Task assignment	
	7. Determine percent of ripple for each load	Practice on task Oral questions	
	8. Plot graph of voltage and load	Performance test	
	9. Plot graph of load and percent ripple		

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MAJOR BLOCK VI
AC POWER SUPPLY

TASK: 3. Install Voltage Divider Circuit
AIM: The student will be able to calculate values and sizes of components for specified needs and install.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Power Supply Components	Related Knowledge		
	I. Uses for the voltage divider	List on chalkboard and discuss	Ref. = 3
	II. Types of divider circuits	Work example problems	
	III. Calculations	Student assignment	
	IV. Use of Zener diode regulators	Drill on lesson	
	V. Use of gas-type regulator tubes	Oral questions	
		Test	
		Discussion	
	Task Detail		
	1. Turn power supply to ON	Demonstrate	Filtered power supply
	2. Measure output voltage		Assortment of bleeder resistors
	3. Connect voltage divider selected		VOM
	4. Observe new voltage		Oscilloscope
	5. Check voltage at taps		Load resistors
	6. Load taps		
	7. Recheck voltage at taps	Discussion of results	
	8. Observe waveform	Student task assignment	
	9. Record results	Review results	
		Performance test	

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MAJOR BLOCK VI AC POWER SUPPLY	TASK: 1. Construct A Complete Power Supply AIM: The student will be able to select the appropriate circuitry and construct a power supply to specifications.		
MINOR BLOCK C	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Construction and Troubleshooting	Related Knowledge I. Circuit design or selection II. Chassis and cabinet III. Metal fabrication IV. Assembly procedures A. Parts B. Wiring V. Testing A. Power OFF B. Power ON	Illustration Calculations Discussion Reading assignments Student reports on assignments Discussion and questions Test Discussion	Ref. # 1
	Task Detail 1. Layout chassis 2. Cut and drill holes 3. Bend to proper shape and size 4. Layout panel 5. Cut and drill holes 6. Apply finish as desired 7. Assemble panel to chassis 8. Mount other parts (except transistors) 9. Wire all parts 10. Check out wiring a. Visually b. Ohmmeter 11. Install transistors (or tubes) 12. Test and evaluate		

MAJOR BLOCK VI AC POWER SUPPLY	TASK: 2. Correct Power Supply Defects AIM: The student will be able to test components of power supply and make necessary repairs.		
MINOR BLOCK C	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Construction and Troubleshooting	Related Knowledge		
	I. Operational theory	Explanation	Ref. # 1
	II. Normal-state tests	Illustration	
	III. Common defects	Reading assignment	
	IV. Resistance(no power) tests	Students report on assignments	
	V. Protection procedures	Student led discussion	
	A. Ballast lamp	Oral questions	
	B. Variable transformer	Test	
	VI. Voltage and current tests	Discussion	
	Task Detail		
	1. Power OFF	Demonstration	VOM, VTVM
	2. Check commonly defective parts		Capacitor bridge Ballast bulb, 300 watts or variable transformer
	3. Test-point measurements		Oscilloscope
	4. Power ON, reduced voltage		Schematic diagram
	5. Voltmeter tests		Defective power supply
	6. Test with full power		Suitable load
	7. Connect load		
	8. Oscilloscope checks	Discussion	
	9. Replace defective part when	Task assignment	
	10. Put in service and check operation	Practice on task	
		Oral questions	
		Performance test	
		Film:	Film: TF 11-2851, Fundamentals of Radio Troubleshooting, Part I, Principle Technique, U.S. Army
		Tell the students what to look for in film	
		Show film	
		Discuss film	
		Test on film	

MAJOR BLOCK VH TRANSISTORS	TASK: 1. Check Static Characteristics Of Transistors AIM: The student will be able to set up test circuit for elementary check on transistors and sort as to basic types.

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Transistor Characteristics	Related Knowledge I. Semi-conductor physics II. Application to transistors III. The three basic electrodes and functions IV. Identifying electrode leads V. Difference between NPN and PNP transistors VI. Transistor symbols VII. Effects of forward and reverse biasing VIII. Runaway current IX. Transistor packaging	Film: Tell the students what to look for in film Show film Discuss film Test on film O-H projector slide or chalkboard Chalkboard drawing Explanation Exhibit and discuss Summarize and review Student asssignment Oral questions Test Discussion	Ref. # 7 Film: TF 11-3047 Semi-conductors and Semi-conductor Diode, U.S. Film: Brattain on Semi-conductor Physics, Bell System Telephone Offices Film: TF 11-3046 Transistors, Part I, Introduction, U.S. Army Film: Genesis of the Transistor, Bell System Telephone Offices

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Transistor Characteristics (continued)	Task Detail 1. Check NPN transistor (from base) 2. Check PNP transistor (from base) 3. Record connections, polarity, and readings for each test 4. Compare polarities for conducting state 5. Assort unmarked transistors into NPN and PNP types 6. Divide into germanium and silicone types	Demonstration Discuss results Film: Tell the students what to look for in film Show film Test on film Summarize with questions Practice on task Review results Oral questions Performance test	Assortment of NPN transistors; germanium and silicon Assortment of PNP transistors; germanium and silicon VOM(1 ½ volts and 1 ma. maximum when set on proper ohmmeter position) Film: TF 11-3048, Transistors, Part III, NPN Transistors, U. S. Army Film: TF 11-3049, Transistors, Part IV, PNP Transistors, U. S. Army

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MAJOR BLOCK VII
TRANSISTORS

TASK: 2. Determine Most Useful Transistor Parameters
AIM: The student will be able to select suitable transistors for specific purposes.

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Transistor Characteristics	Related Knowledge		
	I. Circuit configurations	Illustration on chalkboard	Ref. =7
	A. Common emitter	Explanation	
	B. Common base	Examples on chalkboard	
	C. Common collector	O-H projectuals	
	II. Functions of each		
	III. Current gain		
	A. Alpha		
	B. Beta		
	IV. Circuits for measurements		
	A. Alpha		
	1. NPN		
	2. PNP		
	B. Beta		
	1. NPN		
	2. PNP		
	V. Rules for working with transistors		
	Task Detail		
	1. Arrange circuitry	Demonstration	Two micro-ammeters or suitable VOM's
	a. Alpha test for PNP		1 ea. 100, 220, 10,000 ohm resistors
	b. Beta test for NPN		1 ea. 2-watt, 2,500 and 5,000 ohm potentiometers
	2. Take readings and record		
	3. Arrange circuitry		
	a. Alpha test for NPN		

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MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Transistor Characteristics (continued)	Task Detail (con't.) b. Beta test for NPN 4. Take readings and record	Discussion of results Task assignment Practice on task Oral questions Performance test	2 ea. SPST switches Assortment of PNP and NPN transistors

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MAJOR BLOCK VII TRANSISTORS	TASK: 3. Plot Transistor Characteristic Curves AIM: The student will be able to set up apparatus and run curves for determining usefulness and operating points.		
MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Transistor Characteristics	Related Knowledge I. Characteristic curves A. Common emitter B. Grounded base II. Test circuitry A. PNP B. NPN III. Transistor data sheet A. Description B. Suggested applications C. Mounting and heat sink D. General data 1. Maximum voltage 2. Maximum current 3. Maximum power 4. Maximum temperature E. Suggested parameters and configurations F. Static characteristic curves 1. Output curves 2. Input curves G. Transistor biasing 1. Simple biasing circuit 2. Bias stabilization circuit H. Load line I. Graphical analysis	Definition on chalkboard Explain and discuss Student assignment Drill on lesson Oral questions Test Discussion	Ref. # 7

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Transistor Characteristics (continued)	Task Detail 1. Check Vce-Ic characteristics a. Arrange circuit b. Apply power c. Start with Vce and Ib at zero d. Record values of Ic for small steps of Vce e. Adjust Vce at zero f. Adjust Ib at 50 microamperes g. Record Ic h. Record value of Ic for each value of Vce, maintaining Ib at 50 microamperes i. Remove power 2. Check Veb-Ic characteristics a. Arrange circuitry b. Set Veb at zero c. Set Vcb at zero d. Adjust Vcb in small steps e. Record resulting values of Ic f. Adjust Vcb to zero g. Set and maintain Ic at 1 milliampere h. Record Ic i. Adjust Vcb in small steps j. Record resulting values of Ic 3. Repeat for Ic maintained at: a. 2 milliamperes b. 4 milliamperes c. 6 milliamperes d. 8 milliamperes e. 10 milliamperes f. 15 milliamperes g. 20 milliamperes	Demonstration Discussion of curved plotting Demonstration Student practice Summary and review Performance test	1 ½ and 6 volt sources 2 microammeters or suitable VOM's 470 ohm resistor 2 watt potentiometer 2 SPST switches Transistor 2N217 (or equivalent) with socket

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MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Transistor Characteristics (continued)	Task Detail (con't.) 4. Turn power to OFF 5. Plot curves from data	Review Examination	

MAJOR BLOCK VII TRANSISTORS	TASK: 1. Construct Breadboard Models Of Common-Emitter Amplifier AIM: The student will be able to set up common-emitter amplifier with proper bias and stabilization.		
MINOR BLOCK B	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Small Signal Transistor Amplifiers	Related Knowledge		
	I. Proper type transistor	Discuss data sheets	Ref. # 7
	II. Selection of most suitable transistor	Diagram on chalkboard Explanation	
	III. Common-emitter amplifier circuit	Illustration Reading assignment	
	IV. Amplifier operation	Drill on lesson	
	V. Biasing techniques	Test	
	VI. Circuit stabilization	Discussion	
	Task Detail		
	1. Connect-up common-emitter amplifier a. Connect w/o stabilization b. Check circuit and all polarities c. Apply power d. Feed small signal to input e. Observe (1) Input signal (2) Output signal f. Hold hot soldering iron or lamp near transistor g. Observe (1) No-heat signal output (2) Output with heat (3) Charge in collector current	Demonstrate Discussion Task assignment	6 volt DC source Oscilloscope VOM(20,000 ohms and volts) Audio generator Resistors, 220, 390, 470, 1k, 4, 7k, 10k, 68k ohms Capacitors, 5mfd, 25v. to 25mfd, 6v. SPST 5,000 ohm, 2 watt potentiometer Semiconductor: 2N217 or equivalent, IN34 diode or equivalent

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Small Signal Transistor Amplifiers (continued)	Task Detail (con't.) 2. Record results 3. Reconnect with stabilization circuit 4. Repeat Id and Ig above 5. Record results	Practice on assignment Oral questions Performance test	

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MAJOR BLOCK VII
TRANSISTORS

TASK: 2. Measure Input And Output Impedance
AIM: The student will be able to experimentally determine impedance values of an amplifier.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Small Signal Transistor Amplifiers	Related Knowledge I. Meaning of impedance II. Input impedance III. Output impedance IV. Methods for determining impedance V. Applications	Explanation Illustration Reading assignment Drill on lesson Oral questions Test Discussion	Ref. # 1
	Task Detail 1. Measure input impedance a. Modify circuit b. Apply power c. Feed moderate signal to input d. Determine input impedance (1) Input current-voltage method e. (2) Voltmeter-ohmmeter method e. Remove emitter resistor by pass capacitor f. Re-evaluate input impedance g. Record results 2. Measure output impedance a. Modify circuit for measuring output impedance b. Apply power c. Adjust for moderate output signal	Demonstration of task Discussion Ask questions Task assignment Practice on task Oral questions Performance test	

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Small Signal Transistor Amplifiers (continued)	Task Detail (con't.) d. Read output voltage with no load e. Insert adjustable load resistor f. Adjust until voltage output is one-half that with no load g. Remove resistor and measure its resistance h. Record as output impedance		

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MAJOR BLOCK VII
TRANSISTORS

TASK: 3. Measure Amplifier Gain And Check Phase Relationships
AIM: The student will be able to determine voltage gain, power gain, and phase relationships of an amplifier.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Small Signal Transistor Amplifiers	Related Knowledge		
	I. Meaning of voltage	Define on chalkboard	Ref. # 4
	II. Mathematical calculations	Give examples	
	III. Applications	Explanation	
	IV. Meaning of "power gain"	Reading assignment	
	V. Mathematical calculations	Drill on lesson	
	VI. Applications	Oral questions	
	VII. Value of experimental gain measurements	Test Discussion	
	Task Detail		
	1. Connect up transistor amplifier	Demonstration procedures	
	2. Apply power	Ask and invite questions	
	3. Inject 1000 HZ sine wave	Task assignment	
	4. Set for undistorted output	Practice on task	
	5. Measure output voltage	Oral questions	
	6. Measure input voltage	Performance test	
	7. Calculate ratio		
	8. Record as voltage gain		
	9. Calculate output power		
	10. Calculate input power		
	11. Calculate power gain		
	12. Record results		
	13. Determine phase relationships a. Emitter to base b. Emitter to controller		
	14. Record results		

MAJOR BLOCK VII TRANSISTORS	TASK: 4. Connect And Test Common-Base Amplifiers AIM: The student will be able to set up and test experimental common-base amplifier.		
MINOR BLOCK B	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Small Signal Transistor Amplifiers	Related Knowledge I. Meaning of common-base amplifier II. Operation III. Circuit diagram A. NPN B. PNP IV. Frequency range V. Phase relationships A. Input B. Output VI. Relative gain A. Voltage B. Power VII. Impedance A. Input B. Output	Definition on chalkboard Illustration on chalkboard Discussion Reading assignment Drill on lesson Oral questions Test Discussion	Ref. # 4
	Task Detail 1. Connect common-base amplifier circuit 2. Inject 1000 HZ signal 3. Adjust for undistorted output 4. Measure signal 5. Modify circuit for impedance measurements 6. Measure impedance a. Input circuit b. Output circuit 7. Record measurements	Demonstration	1.5 V and 6v. power source VTVM, Oscilloscope Audio generator (low impedance) Resistors: 470, 1,000, 2,200, 4,700, 5,600, 22,000 ohm, 1/2 watt Capacitors: 50mfd./25v., two 25mfd./12v. Semiconductors: 2N217 or equivalent, 1N34 diode

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Small Signal Transistor Amplifiers (continued)	Task Detail (con't.) 8. Compare power gain 9. Check phasing a. Input b. Output 10. Record results	Discuss results Ask questions Student assignment Student practice Summary with oral questions Performance test	Potentiometers: 500-ohm, 2-watt, 100k ohms, 2 watt

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MAJOR BLOCK VII

TRANSISTORS

TASK: 5. Connect Up And Test Common-Collector Amplifier

AIM: The student will be able to use the common-collector amplifier where best suited for specific need.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Small Signal Transistor Amplifiers	Related Knowledge		
	I. Operation	Explanation	Ref. # 7
	II. Characteristics	Illustration	
	A. Voltage gain	Reading assignment	
	B. Power gain	Drill on lesson	
	C. Phase relationships	Oral questions	
	D. Impedance	Test	
	III. Special uses	Discussion	
	Task Detail		
	1. Connect up circuit	Demonstrate	Variable, regulated D-C sources, signal generator, VTVM, oscilloscope
	2. Measure voltage gain		Resistors: 12K, 1 megohm, 4.7 kilohms, 500 ohm potentiometer
	3. Record		Capacitors: 50 mfd./25v., 25 mfd./12v.
	4. Measure input impedance		Semiconductors: 2N410 or equivalent
	5. Measure output impedance		Two SPST switches
	6. Record		
	7. Compute power gain		
	8. Check phase relationships		
		Diagram on chalkboard	
		Ask questions	
		Discussion	
		Student practice	
		Review results	
		Oral questions	
		Performance test	

MAJOR BLOCK VII
TRANSISTORS

TASK: 6. Develop Maximum-Dissipation Curve
AIM: The student will be able to predict the operating conditions of an amplifier and adjust for optimum performance.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Small Signal Transistor Amplifiers	Related Knowledge		
	I. Meaning of "load-line"	O-H projectuals	Ref. # 7
	II. Uses of the load-line	Explanation	
	III. Collectors dissipation curves	Illustration	
	IV. D-C load-line	Reading assignment	
	V. Predicting amplifier characteristics	Drill on lesson	
		Oral questions	
		Test	
		Discussion	
	Task Detail		
	1. Set up common-emitter amplifier circuit	Demonstrate	Variable, regulated D-C source
	2. Set bias at cut-off of Ic		VTVM
	3. Close SW, ajust Ib to .1ma		0-1 ma: 0-50 ma. D.C. milliammeters
	4. Record Ib, Ic, Vce, Veb		100 and 1,200 ohm resistors
	5. Repeat for Ib set at: a. .2ma. b. .3ma. c. .4ma.		2N217 transistor or equivalent
	6. Compute collector current gain a. Ib = .2ma. b. Ib = .4ma.		SPST switch
			50,000 ohm, 2 watt potentiometer
	7. Graph and plot "load-lines"	Discussion of results	
		Student assignment	
		Practice on assignment	
		Review and summary	
		Performance test	

MAJOR BLOCK VII TRANSISTORS	TASK: 7. Determine The Dynamic Range Of Cascaded Amplifiers AIM: The student will be able to set up and use cascaded amplifiers.		
MINOR BLOCK B	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Small Signal Transistor Amplifiers	Related Knowledge		
	I. Meaning of cascaded amplifiers	Definition	Ref. # 7
	II. Need	Illustration	
	III. Operating characteristics	Discussion	
	IV. Types	List and discuss	
	V. Input and output impedance	O-H projectuals of various circuits	
		Reading assignment	
		Student reports and discussion	
		Oral questions	
		Test	
		Discussion	
	Task Detail		
	1. Connect up R-C amplifier, common-emitter type	Demonstration	Parts for two stage amplifiers
	2. Apply power		Oscilloscope, VTVM
	3. Inject 100 H_z signal		AF sine-wave generator
	4. Increase audio generator to 30 millivolts output		Headphones(or speaker with amplifier)
	5. Leave control set	Discussion	
	6. Measure all signal points(peak to peak with oscilloscope)	Task assignment Practice on task	
	7. Measure D-C at same points	Oral questions	
	8. Measure total current	Performance test	
	9. Record all measurements		
	10. Remove coupling capacitor		
	11. Note sound, record		
	12. Repeat all measurements		
	13. Record all measurements		

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Small Signal Transistor Amplifiers (continued)	Task Detail (con't.) 14. Turn off power 15. Leave volume control set 16. Indirect calculation of weak input a. Disconnect center arm to potentiometer b. Measure resistance from center to ground c. Record measurement d. Measure total resistance of control e. Using 30 mv. input, compute signal to amplifier 17. Connect phono-pickup to volume control 18. Determine maximum signal before distorting appears on oscilloscope	Review Examination	

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SECOND YEAR

MAJOR BLOCK VIII AMPLIFICATION	TASK: 1. Determine Triode Characteristics AIM: The student will be able to interpret tube manual data to select proper tube and operation conditions.		
MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Vacuum Tube Triode	Related Knowledge		
	I. Diode principles	Explain principles	Ref. # 6
	II. Diode construction		
	III. Diode operation		Ref. # 7
	IV. The triode grid	Exhibit tungar rectifier	
	V. Triode operation	Show examples	
	VI. Biasing	Explain with chalkboard	
	VII. Modes	Discuss modes	
	A. Class A		
	B. Class B		
	C. Class C	List and explain briefly characteristics	
	VIII. Biasing		
	IX. Static characteristics	Graph on chalkboard	
	X. Dynamic characteristics		
	Task Detail		
	1. Test characteristics of diode	Demonstrate	VTVM two VOM's
	a. Connect into test circuit		2,200 ohm resistor
	b. Reduce applied voltage to zero		6AL5 and 12AU7 tube or similar w/sockets
	c. Apply power		
	d. Read current through circuit		SPST switch
	e. Read applied voltage		Variable-voltage power supply
	f. Record 4 and 5		
	g. Increase applied voltage in small steps	Discussion Task assignment	Adjustable bias supply
	h. Record results of each step	Practice on task	

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Vacuum Tube Triode (continued)	Task Detail (con't.) 2. Test characteristics of triode a. Mutual characteristics (1) Connect into test circuit (2) Adjust plate voltage to 80v. (3) Adjust grid bias to zero (4) Apply power (5) Read and record Ip (6) Increase Eg in negative $1\frac{1}{2}$ volt steps (7) Record Ip readings (8) Graph results b. Plate characteristics (1) Adjust Vg to zero volts (2) Read and record, Ip (3) Repeat for Vg -2V, -4V, -6V, -8V, -10V, -12V, -14V (4) Record results in table c. Dynamic characteristics (1) Determine amplification from graphs (2) Determine a-c plate resistance from graphs (3) Determine mutual conductance from graphs	Oral questions Performance test	

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MAJOR BLOCK VIII
AMPLIFICATION

TASK: 2. Determine Class "A" Amplification Characteristics
AIM: The student will be able to properly adjust operation conditions for minimum signal distortion.

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Vacuum Tube Triode	Related Knowledge		
	I. Class "A" operating conditions II. Linear operation III. Circuit voltage-gain IV. Interpretation of data sheet	Illustrate and explain Transparencies or manual Reading assignment Drill on lesson Oral questions Test Discussion	Ref. = 6 Ref. = 7
	Task Detail		
	1. Set up circuit 2. Adjust Vg to zero 3. Apply power 4. Maintain B+ at 200V. 5. Record Vp at Vg = 0 6. Record Vp at Vg = -4, -8, -12, -16, -20 volts 7. Plot graph 8. Compute gain at each point 9. Determine linear portion of curve	Demonstrate Discussion Task assignment Practice on task Oral questions Performance test	200 V plate power supply 0-20 V variable bias source Two VTVMs or VOMs 22K resistor 12AU7 tube w/socket or equivalent 10K potentiometer, 2-watt

MAJOR BLOCK VIII AMPLIFICATION	TASK: 3. Adjust Cathode Bias On Amplifier Stage AIM: The student will be able to select cathode bias resistor and bypass capacitor.		
MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Vacuum Tube Triode	Related Knowledge		
	I. Meaning of bias	Define on chalkboard	Ref. # 6
	A. Fixed	Explain with graphs	
	B. Self-bias	Examples on chalkboard	Ref. # 7
	II. Determining bias requirements	Explain	
	III. Calculating proper cathode-circuit resistor	Discussion Reading assignment	
	IV. Degeneration	Drill on lesson	
	V. Cathode-resistor bypass resistor	Oral questions Test	
	VI. Calculation of by-pass capacitor	Discussion	
	VII. Relative gain		
	A. Without capacitor		
	B. With capacitor		
	Task Detail		
	1. Set up circuit	Demonstrate	Power supply, variable d-c Oscilloscope, VTVM, VOM Resistors: 4.7K, (2) 270K, 470K, others assorted 10K potentiometer, 2 watt 6AV6 tube w/socket or similar
	2. Adjust signal Vg to ½ V peak-peak		
	3. Measure d-c voltage points		
	4. Observe signal waveform and voltage		
	5. Replace cathode by-pass capacitor (50mfd.) with -1mfd		
	6. Compare with previous signal		
	7. Compute gain	Discussion	
	a. With by-pass	Task assignment	
	b. Without by-pass	Practice on task	
	8. Reconnect 50 mfd. capacitor	Film:	Film: TF 11-3419, Basic Amplifiers, U.S. Army
	9. Replace cathode resistor with	Tell students what to look	

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Vacuum Tube Triode (continued)	Task Detail (con't.) 10K potentiometer 10. Repeat above steps with cathode resistance varied in increments 11. Record gain each increment	for in film Show film Discuss film Test on film Oral questions Performance test	

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MAJOR BLOCK VIII
AMPLIFICATION

TASK: 4. Construct Cathode-Follower Amplifier
AIM: The student will be able to connect and properly utilize the cathode-follower amplifier circuit.

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Vacuum Tube Triode	Related Knowledge		
	I. Operation of cathode-follower	Explain on chalkboard	Ref. # 6
	II. Voltage gain	Discuss	
	III. Power gain	List on chalkboard	Ref. # 7
	IV. Impedance		
	A. Input		
	B. Output		
	V. Practical application		
	Task Detail		
	1. Connect circuit	Demonstration using previously used apparatus	
	2. Adjust signal input to 3V., peak-peak	Draw on chalkboard	
	3. Measure output signal	Task assignment	
	4. Compute no-load voltage gain	Practice on task	
	5. Connect load and adjust to known resistance value	Oral questions	
	6. Measure input resistance	Performance test	
	7. Calculate power gain	Review	
		Examination	

MAJOR BLOCK VIII
AMPLIFICATION

TASK: 1. Construct Breadboard Of Simple Power Amplifier
AIM: The student will be able to develop and check a simple tube amplifier for specific need.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Power Amplifier	Related Knowledge		
	I. Power amplifier characteristics	Explain	Ref. # 7
	A. Unique requirements	Block diagram	
	B. One or multi-stage	Work examples	
	C. Single-ended or push-pull	Ask and answer questions	
	D. Loading	Work example problems	
	E. Power transfer	Explain	
	F. Distortion	Discuss use	
	II. Decibel gain or loss	Work examples	
	A. The unit Bel	Discuss	
	B. Calculations	Reading assignment	
	III. Use of output meter	Drill on lesson	
	A. Function	Oral questions	
	B. VTVM and VOM	Test	
	C. Impedance calculation	Discussion	
	IV. Degenerative feedback		
	Task Detail		
	1. Connect up amplifier circuit	Demonstrate	Oscilloscope, VTVM, VOM
	2. Connect dummy load		AF sine-wave generator
	3. Measure d-c voltage at all test points		Variable 6.3-volt AC source
	4. Measure a-c voltage across dummy load		Parts for assembling amplifier
	5. Inject 10 volt, 1,000H_z signal	Draw on chalkboard	5 ohm, 4 watt resistor
	6. Repeat (3) and (4)	Explain	
	7. Record all measurements	Discussion	
	8. Observe waveform	Task assignment	
	9. Record	Practice on task	
	10. Remove cathode by-pass	Oral questions	
	11. Observe and measure waveform	Performance test	
	12. Record		

MAJOR BLOCK VIII
AMPLIFICATION

TASK: 2. Construct And Check Solid State Power Amplifiers
AIM: The student will be able to select most feasible type of amplifiers and make application.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Power Amplifier	Related Knowledge		
	I. Rating power transistors	Discuss examples	Ref. # 6
	A. Power rating	Work examples on chalkboard	
	B. Voltage rating	Exhibit	Ref. # 7
	C. Current rating	Discuss	
	II. Types	Explain	
	A. Point-contact	List on chalkboard	
	B. Junction	Discuss	
	III. Thermal runaway	Discuss circuitry	
	IV. Increasing dissipation	Show on chalkboard	
	V. Applications	Briefly discuss	
	VI. Input phasing	Discuss	
	A. Paraphase amplifiers	Reading assignment	
	1. Single transistor	Drill on lesson	
	2. Two transistor	Oral questions	
	B. Center-tapped transformer	Test	
	VII. Driver impedance matching	Discussion	
	VIII. Cross-over distortion		
	Task Detail		
	1. Connect up circuit	Demonstration	Oscilloscope
	a. Transformer drive		Sine-wave AF generator
	b. Single transistor paraphase driver		VTVM, 10K/volt VOM
			Parts for circuits
	c. Two transistor paraphase driver	Exhibit on chalkboard Explain and discuss	
	2. Check operation	Exhibit on chalkboard	
	a. Waveform	Explain and discuss	
	b. Power output	Review procedures	
	c. Power gain	Discussion	
	3. Record	Task assignment Practice on task	

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Power Amplifier (continued)	Task Detail (con't.)	Oral questions Performance test	

MAJOR BLOCK VIII
AMPLIFICATION

TASK: 3. Match Output Load To Amplifier
AIM: The student will be able to determine optimum amplifier loading and calculate suitable matching transformer ratio.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Power Amplifier	Related Knowledge		
	I. Types of loads	Transparencies	
	A. Speakers	Discuss	
	1. Magnetic	Give examples	
	2. Dynamic	Explain	
	3. Electrostatic	Examples on chalkboard	
	B. Other load devices	Discuss	
	1. Piezo-electric	Work examples	
	2. Magneto-striction	Diagram on chalkboard	
	3. Motors	Discuss	
	4. Recorders	Reading assignment	
	5. Power converters	Drill on lesson	
	6. Frequency converters	Oral questions	
	II. Impedance problems	Test	
	A. D-C or A-C	Discussion	
	B. Reactive or non reactive		
	C. High or low		
	III. Matching devices		
	A. Experimental measurements		
	B. Calculations		
	1. Power requirements		
	2. Turns ratio		
	IV. Phasing of units		
	V. Efficiency of the system		
	Task Detail		
	1. Set up amplifier system	Demonstrate	Suitable power amplifier
	2. Load with resistor (R)		Adjustable load resistor(s)
	3. Inject 1,000 H_z signal		VTVM or VOM
	4. Monitor on oscilloscope		Sine-wave signal source
	5. Set to just under distortion		Oscilloscope

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Power Amplifier (continued)	Task Detail (con't.)		
	6. Measure IR and ER		
	7. Compute power and record	Block diagram on chalkboard	
	8. Repeat for various values of R	Work examples	
	9. Select optimum load resistance	Show procedure	
	10. Record as "Z"	Explain	
	11. Identify impedance of load to be matched	Work examples Review procedure	
	12. Compute "Z" ratio	Discussion	
	13. Compute square-root of "Z" ratio	Task assignment Practice on task	
	14. Record as turns - ratio	Oral questions	
	15. Select proper transformer or tap	Performance test	

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MAJOR BLOCK VIII AMPLIFICATION	TASK: 4. Measure Frequency Response Of Audio Amplifier AIM: The student will be able to make proper set-up and evaluate performance of an audio amplifier.		
MINOR BLOCK B	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Power Amplifier	Related Knowledge		
	I. Audio frequencies	Define on chalkboard	Ref. # 6
	A. Range	List "limits"	
	B. Wave shapes	Oscilloscope patterns	Ref. # 8
	II. Frequency response	Explain	
	A. Output relative to input	Illustration	
	B. Rating procedures	Reading assignment	
	C. Problems in standards	Drill on lesson	
	D. Extending frequency responses	Oral questions Test Discussion	
	Task Detail		
	1. Connect up system	Demonstrate	Suitable amplifier
	a. To known load		Oscilloscope(s)
	2. Apply power		Sine-wave generator 10-100
	3. Inject low value 1,000 Hz		Suitable load resistance
	4. Observe oscilloscope		
	5. Increase input to ½ that which distorts; maintain	Block diagram on chalkboard	
	6. Record output voltage		
	7. Record output at entire range of frequencies	Illustration	
	8. Compute power at each step	Discussion	
	9. Graph curve of power versus frequency	Task assignment Practice on task	
	10. Draw a line between upper and lower half-power points	Oral questions Performance test	
	11. Determine frequency range between these points	Review Examination	

MAJOR BLOCK IX OSCILLATORS	TASK: 1. Check Function And Use Of Oscillators AIM: The student will be able to describe the function and use of oscillators.		
MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Oscillator Characteristics	Related Knowledge I. DC to AC II. Tank circuit III. Frequency generation A. Vacuum tube B. Transistor IV. Positive feedback V. Tuned circuit VI. Applications	Discussion Illustrate on chalkboard Reading assignment Tell students what to look for in film Show film Discuss film Test	Ref. # 7 Ref. # 4 Film: TF 11-1831, Tuned Circuits, U.S. Army

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MAJOR BLOCK IX

OSCILLATORS

TASK: 2. Devices Using Oscillators

AIM: The student will be able to select appropriate oscillator circuit for the device and set up for operation.

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Oscillator Characteristics	Related Knowledge		
	I. Attributes of basic circuits	Explanation	Ref. # 7
	II. Electrical requirements	Illustration	
	III. Mechanical requirements	Reading assignments	Ref. # 4
	IV. Types of applications	Student reports on assignments	
	V. Circuit operation of each	Oral questions	
	VI. Critical factors of fabrication	Tell students what to look for in film Show film Discuss film Test on film	Film: TF 11-3050, Transistor, Part V, Transistor Amplifier and Oscillator Circuits, U. S. Army
	Task Detail		
	1. Examine circuitry	Demonstrate sample of task elements	
	2. Select suitable parts		
	3. Assemble, one method	Discussion on sample element	
	a. Breadboard style	Reading assignment	
	b. Temporary construction	Individual task assignments	
	c. Prototype design	Practice on tasks	
	4. Test and record results	Reports from students on task	
	5. Evaluate effectiveness	Student led discussions Oral questions Performance test	

MAJOR BLOCK IX OSCILLATORS	TASK: 1. Assemble And Check Armstrong Oscillator AIM: The student will be able to assemble, check, and properly utilize the Armstrong oscillator in practical circuit.		
MINOR BLOCK B	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Oscillator Types	Related Knowledge		
	I. Oscillating tank circuit	Oscilloscope display	Ref. # 4
	II. Requirements for sustained oscillators	Explain on chalkboard Diagram on chalkboard	
	III. Feed-back system	Explain	
	A. Special uses	Tuning forks (or guitar)	
	B. Operation	Oscilloscope pattern	
	IV. Armstrong oscillator circuit	Reading assignment	
	A A. Heterodyne method	Drill on lesson	
	B. Operation	Oral questions	
	V. Frequency measurement	Test	
	A. Heterodyne method	Discussion	
	B. Lissajous method		
	Task Detail		
	1. Wind turned coil	Demonstrate	A-M radio
	a. Ninety turns		Suitable power supply or batteries, 1 ½" cardboard cord form, 100 ft. #28 magnet wire (or similar)
	b. #28 Magnet wire		
	2. Mount vertically		
	3. Wind tickler coil		
	a. Size to slip over tuned coil		365 mmf. variable capacitor
	b. 30 turns	Diagram on chalkboard	
	c. #28 Magnet wire	Explain	
	4. Connect up circuit	Illustration	
	5. Apply power	Reading assignment	
	6. Tune radio to station	Drill on lesson	

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Oscillator Types (continued)	Task Detail (con't.) a. High frequency end b. Center frequency end c. Low frequency end 7. Tune oscillator a. Listen for "beat" b. Throughout range 8. If no signal a. Reverse tickler coil b. Couple closer 9. Note "beat" a. Heterodyne effect b. Zero point 10. Modulate a. Absorption loop b. 10--turn coil c. Telephone "transmitter" 11. Power "off"	Oral questions Test Discussion	

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MAJOR BLOCK IX

OSCILLATORS

TASK: 2. Assemble Hartley Oscillator And Analyze

AIM: The student will be able to set up and check and properly operate Hartley Oscillator.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Oscillator Types	Related Knowledge		
	I. Circuit arrangements	Diagram on chalkboard	Ref. # 4
	A. Series	Explain	
	B. Shunt	Discuss questions	
	II. Similarity to Armstrong Oscillator	Illustration	
		Reading assignment	
	III. Operation	Drill on lesson	
	IV. Advantages	Oral questions	
		Test	
		Discussion	
	Task Detail		
	1. Connect up simple Hartley circuit	Demonstration	Suitable power supplies
			R-F signal generator
	2. Apply power		Oscilloscope w/demodulator probe
	3. Observe waveform		
	4. Measure signal with VTVM and oscilloscope		VTVM - VOM
	a. Input		Oscillator parts for A-M band
	b. Output		A-M receiver
	5. Add stabilization network		
	6. Observe results and record	Explaining on chalkboard	
	7. Change to demodulator probe	Oscilloscope display	
	8. Connect signal generator	VTVM	
	9. Measure range of oscillator frequency	Discuss results	
		Task assignment	
	10. Key oscillator circuits	Practice on task	
	11. Note "chirp"	Oral questions	
	12. Record results	Performance test	

MAJOR BLOCK IX OSCILLATORS	TASK: 3. Connect Colpitts Oscillator AIM: The student will be able to identify and describe operational characteristics and put into operation.		
MINOR BLOCK B	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Oscillator Types	Related Knowledge		
	I. Colpitts circuit	Diagram on chalkboard	Ref. # 4
	II. Capacitor voltage divider	Explain	
	III. Feedback arrangement	Trace on diagram	
	IV. Advantages	Discuss	
		Illustration	
		Reading assignment	
		Drill on lesson	
		Oral questions	
		Test	
		Discussion	
		Demonstrate using previously used oscillator apparatus	
		One additional 356 mmf. variable capacitor	
	Task Detail		
	1. Assemble circuit	Diagram on chalkboard	
	2. Tune in on receiver	Discussion	
	a. Broadcast band	Task assignment	
	b. Zero beat	Practice on task	
	3. Proportion feedback capacitors	Oral questions	
		Performance test	
	a. Maximum stability		
	b. Useable power output		
	4. Record results		

MAJOR BLOCK IX OSCILLATORS	TASK: 4. Set Up And Check Crystal Oscillators AIM: The student will be able to construct and properly operate crystal type oscillators.		
MINOR BLOCK B	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Oscillator Types	Related Knowledge		
	I. Piezo-electric action	Explanation	Ref. # 7
	II. Crystal function in circuit	Illustration	
	III. Oscillator circuits	Reading assignment	
	A. Pierce	Drill on lesson	
	B. Tuned types (fundamental)	Oral questions	
	C. Overtone circuit	Test	
	IV. Advantages and limitations	Discussion	
	V. Tuning problems		
	VI. Proper loading		
	VII. Frequency checking		
	VIII. Crystal testing		
	Task Detail		
	1. Wire up Pierce circuit	Demonstration	Parts for oscillator circuits
	2. Connect power supply		Assorted crystals
	3. Monitor current to oscillator		VTVM
	4. Gradually raise voltage		Grid-dip oscillator
	5. Note point of oscillation		Absorption wavemeter
	6. Measure grid voltage		Multi-band receiver
	7. Measure frequency		Adjustable power supply
	a. Grid dip oscillator		Breadboard system or chassis
	b. Radio receiver		
	8. Determine output	Discussion	
	9. Change crystal	Task assignment	
	10. Repeat	Practice on task	
	11. Record observation	Oral questions	
	12. Modify to tuned circuit types	Performance test	
	13. Adjust tune circuit types		

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Oscillator Types (continued)	Task Detail (con't.) 14. Measure frequency a. Grid-dip oscillator b. Absorption wavemeter c. Radio receiver d. Output power 15. Record results		

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MAJOR BLOCK X

RECEPTION

TASK: 1. Construct Detector Circuit

AIM: The student will be able to connect and check circuit for demodulating an A-M signal.

MINOR BLOCK - A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Tuning And Amplification	Related Knowledge		
	I. Unmodulated R-F signal	Transparencies or chalkboard	Ref. # 6
	II. Amplitude modulated signal	Chalkboard illustration and	
	III. Demodulation (detection)	explanation	Ref. # 3
	IV. Detectors	Explain and discuss	
	A. Natural crystals	Reading assignment	
	B. Manufactured types	Drill on lesson	
	1. Semi-conductor	Oral questions	
	2. Diode tube	Test	
	3. Triode tube	Discussion	
	Task Detail		
	1. Check R-F generator signal on oscilloscope	Demonstrate	Oscilloscope w/R-F probe VTVM R-F signal generator w/modulation Parts for T-R-F receiver
	2. Set up experimental detector circuit		
	3. Check detector circuit functions		
	a. R-F signal only	Discussion	
	b. Modulated R-F signal	Task assignment	
	c. Detector output	Practice on task	
	(1) Unmodulated carrier	Oral questions	
	(2) Modulated carrier	Performance test	
	(3) Detector action		
	(4) Reversed diode results		
	(5) R-F by-pass removed		

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MAJOR BLOCK X RECEPTION	TASK: 2. Add Tuned Radio-Frequency Stage AIM: The student will be able to set up and adjust radio frequency amplifier to predetermined frequency.		
MINOR BLOCK A	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Tuning And Amplification	Related Knowledge		
	I. Antenna coupling	Diagrams and explanations	Ref. # 3
	A. Direct	Diagrams on chalkboard and	
	B. Capacity	$60H_z$ model	
	C. Tapped	Display types	
	D. Inductive	Explain and discuss	
	II. Resonant circuit	Reading assignment	
	A. Variable inductor	Drill on lesson	
	1. Air core	Oral questions	
	2. Ferrite core	Test	
	B. Variable capacitor	Discussion	
	1. Variable area		
	2. Variable spacing		
	III. Complete T-R-F receiver		
	A. Antenna system		
	B. Tuned stage		
	C. Detector		
	D. Audio amplifier		
	Task Detail		
	1. Complete assembly of T-R-F receiver	Demonstration Illustration	
	2. Measure and record each station received:	Reading assignment Drill on lesson	
	a. Detector output	Oral questions	
	b. First audio amplifier	Test	
	(1) Input	Discussion	
	(2) Output		
	c. Second audio amplifier		
	(1) Input		
	(2) Output		

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MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Tuning And Amplification (continued)	Task Detail (con't.) d. Band width covered 3. Disassemble or mount parts permanently for further use	 Review Examination	

MAJOR BLOCK X RECEPTION	TASK: 1. Construct Audio Section Of Superheterodyne Receiver AIM: The student will be able to layout, fabricate, assemble, and test audio amplifier section.		
MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
A-M Superheterodyne	Related Knowledge		
	I. First audio stage	Explain and discuss	Ref. # 1
	A. Types	Illustrate on chalkboard	
	B. Requirements	List and explain	
	1. Gain	Discussion	
	2. Fidelity	Explain	
	C. Operation of circuit	Student led discussion	
	D. Function of each part	Explain and discuss	
	II. Final stage function	Measurement	
	A. Gain	Measure and calculate	
	1. Voltage	Calculate on chalkboard	
	2. Current	List and discuss	
	3. Power	Explain	
	B. Types	Student led discussion	
	C. Operation	Reading assignment	
	D. Function of each part	Drill on lesson	
	E. Impedance	Oral questions	
	1. Resistive load	Test	
	2. Speaker load	Discussion	
	3. Line loading		
	F. Construction problems		
	1. Audio feedback		
	2. Heat dissipation		
	Task Detail		
	1. Layout	Demonstrate	Parts for assembly
	a. Printed circuit technique		Adjustable power supply
	(1) Rough-sketch arrangement		Audio-signal generator
	(2) Finish on ruled acetate		Oscilloscope
	(a) India ink (or)		Printed circuit board supplies
	(b) Printed-circuit tape		

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
A-M Superheterodyne	Task Detail (con't.)		
	b. Hand-wiring technique		Hand-wiring supplies
(continued)	(1) Rough sketch arrangement	Discussion	
	(2) Draw to scale on paper	Task assignment	
	(3) Transfer to sheet metal	Practice on task	
	2. Fabricate	Oral questions	
	a. Printed-circuit technique	Performance	
	(1) Sensitize silk screen		
	(2) Allow to dry in dark place		
	(3) Expose through circuit drawing		
	(4) Wash out circuit areas		
	(5) Tough-up and dry		
	(6) Trim and clean circuit board		
	(7) Print circuit and dry		
	(8) Etch off unwanted metal		
	(9) Drill holes		
	b. Hand-wiring technique		
	(1) Center-punch all holes		
	(2) Drill, small holes first		
	(3) Clean burrs		
	(4) Paint if necessary		
	3. Assemble		
	a. Printed-circuit techniques		
	(1) Install resistors		
	(2) Install capacitors		
	(3) Install other parts		
	(4) Solder in place		
	(5) Install semiconductors		
	(6) Solder semiconductors		
	(a) Observe polarity		
	(b) "Heat sink" each lead		
	b. Hand-wiring techniques		
	(1) Install sockets		
	(2) Install tie-points and plugs		
	(3) Install other parts		

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
A-M Superheterodyne (continued)	Task Detail (con't.) (4) Wire A-C circuits, dress (5) Wire D-C circuits, dress (6) Wire signal circuits, dress (7) Solder all circuits, dress 4. Connect to power supply and speaker 5. Test amplifier a. Gain b. Power c. Distortion 6. Record results		

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MAJOR BLOCK X RECEPTION	TASK: 2. Connect Detector - AGC Circuits AIM: The student will be able to select suitable type detectors and AGC: install and check operation of detector - AGC section.		
MINOR BLOCK B	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
A-M Superheterodyne	Related Knowledge		
	I. Second detector	Explain with chalkboard	Ref. # 1
	A. Purpose	Explain	
	B. Types	Student led discussion	
	C. Circuitry	Transparencies	
	D. Operation	Reading assignment	
	E. Function of each part	Drill on lesson	
	II. Automatic gain control	Oral questions	
	A. Purpose	Test	
	B. Types	Discussion	
	C. Circuitry		
	D. Operation		
	E. Function of each part		
	Task Detail		
	1. Install 2nd detector parts	Demonstrate	Audio amplifiers
	2. Connect to audio input		R-F signal generator w/modulation
	3. Check operation		
	a. Apply modulated (IF signal)		Oscilloscope or VTVM
	b. Check audio output	Discussion	
	c. Compare with 1st audio output	Task assignment	
	4. Install AGC parts	Practice on task	
	5. Check AGC voltage	Oral questions	
	a. No modulation	Performance test	
	b. With modulation		
	6. Record results		

MAJOR BLOCK X

RECEPTION

TASK: 3. Install Intermediate Frequency Amplifier

AIM: The student will be able to analyze and align I-F amplifier.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
A-M Superheterodyne	Related Knowledge		
	I. I-F amplifier	Explain on chalkboard	Ref. # 1
	A. Function	Explain and discuss	
	B. Relative efficiency	Illustrate on chalkboard	
	C. Requirements	Explain using transparencies	
	1. Frequency	Show examples	
	2. Band-pass	Explain	
	3. Gain	Reading assignment	
	D. Types of coupling	Drill on assignment	
	E. Operation	Oral questions	
	F. Tuning	Test	
	1. Systems	Discussion	
	2. Objectives		
	Task Detail		
	1. Install I-F amplifier parts	Demonstrate	I-F amplifier parts
	2. Connect into 2nd detector circuit		R-F signal generator
	3. Connect test apparatus		Oscilloscope or VTVM
	a. Signal generator		Detector - AGC - Audio system
	b. Oscilloscope on output		
	c. VTVM on AGC circuit		
	4. Test I-F amplifier		
	a. Check performance		
	b. Adjust to frequency		
	5. Record results		

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MAJOR BLOCK X

RECEPTION

TASK: 4. Connect Local Oscillator

AIM: The student will be able to select oscillator circuit, install, and check.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
A-M Superheterodyne	Related Knowledge		
	I. Heterodyne action	Block diagram	Ref. # 1
	A. Sum frequency	Math examples	
	B. Difference frequency	Transparencies	
	C. Harmonic-related frequencies	Explain using chalkboard	
		Reading assignment	
	D. Images	Student led discussion	
	II. Types of circuitry	Drill on lesson	
	A. Self excited	Test	
	B. Crystal	Discussion	
	III. Operation of each		
	IV. Coupling		
	V. Tracking		
	VI. Purpose of each part of circuit to be used		
	Task Detail		
	1. Install oscillator parts	Demonstration	Oscillator parts
	2. Re-check circuitry		R-F signal generator
	3. Check oscillator (455KH_z)		Oscilloscope and VTVM
	a. Oscilloscope if suitable		Functioning A-M radio
	b. A-M radio tuned to station between 1000-1600 KH_z	Discussion	
		Task assignment	
	c. VTVM	Practice on task	
	4. Record frequency-range	Oral questions	
		Performance test	

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MAJOR BLOCK X

RECEPTION

TASK: 5. Connect Frequency Converter

AIM: The student will be able to combine R-F signal, oscillator, and I-F amplifier circuits.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
A-M Superheterodyne	Related Knowledge		
	I. Frequency conversion	Transparencies or chalkboard	Ref. # 7
	A. Function	Describe	
	B. Types	List, explain	Ref. # 4
	1. Oscillator and detector	List, discuss	
	2. Oscillator with detector	Explain w/ mathematics	
	3. Operation	Reading assignment	
	C. Requirements	Student led discussion	
	D. Alignment	Drill on lesson	
	E. Purpose of each part	Test	
		Discussion	
	Task Detail		
	1. Connect converter circuit	Demonstrate	Frequency converter parts
	2. Re-check circuitry		Suitable test equipment
	3. Power the system	Discussion	
	4. Couple R-F generator	Task assignment	
	5. Align 1st detector	Practice on task	
	6. Check AGC voltage	Oral questions	
	7. Check for image signals	Performance test	
	8. Record results		

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MAJOR BLOCK X

RECEPTION

TASK: 6. Add Radio-Frequency Amplifier

AIM: The student will be able to improve receiver performance, match, and align R-F amplifier.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
A-M Superheterodyne	Related Knowledge		
	I. R-F amplification	Diagram; transparencies or chalkboard	Ref. # 4
	A. Function	Explain	
	B. Operation	Ask questions, discuss	
	C. Requirements	List on chalkboard and explain	
	1. Frequency	Explain	
	2. Band-pass	Reading assignment	
	3. Image rejection	Drill on lesson	
	4. Intermodulation refunction	Oral questions	
	D. Alignment problems	Test	
	E. Impedance matching	Discussion	
	Task Detail		
	1. Install R-F amplifier parts	Demonstrate	Parts for R-F amplifier
	2. Check performance		Suitable test equipment
	a. Signal strength	Discussion	
	b. Image rejector	Task assignment	
	3. Align with signal generator	Practice on task	
	4. Connect long-wire antenna	Oral questions	
	5. Re-check R-F alignment	Performance test	
	6. Impedance-match antenna		
	7. Re-check R-F alignment		
	8. Record results		

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MAJOR BLOCK X RECEPTION	TASK: 7. Install A Beat-Frequency Oscillator AIM: The student will be able to design and install suitable BFO in receiver for reception of C-W signals.		
MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
A-M Superheterodyne	Related Knowledge		
	I. Purpose of BFO	Explanation	Ref. # 4
	II. Requirements of BFO	Illustration	
	III. Mixing procedures	Reading assignment	
	IV. Suitable oscillators	Drill on lesson	
	V. Frequency-adjustments	Oral questions	
	A. Fixed	Test	
	B. Manual	Discussion	
	VI. Proper use		
	Task Detail		
	1. Install tuned circuit	Demonstration	Functioning receiver
	2. Install tube socket(if VT ckt.)		Parts for BFO (tube or transistor)
	3. Install associated resistors		
	4. Install associated capacitors		VTVM
	5. Install BFO switch		R-F signal generator
	6. Complete wiring	Discussion	
	7. Install transistor (if not VT ckt.)	Task assignment	
	8. Test output	Practice on task	
	9. a. VTVM	Oral questions	
	b. Listening test	Performance test	
	9. Adjust to I-F frequency		
	10. Check operation on weak signal	Review	
	11. Adjust output of BFO if necessary	Examination	
	12. Re-adjust frequency of BFO		

MAJOR BLOCK XI TRANSMISSION	TASK: 1. Construct Small C-W Transmitter AIM: The student will be able to assemble and test a basic radio transmitter.		
MINOR BLOCK A	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
R-F Transmitter	Related Knowledge		
	I. R-F transmitter as a system	Explain w/block diagram	Ref. # 4
	A. Oscillator	Explain and discuss using bread-boarded circuit	
	B. Amplifier		
	C. Power source	Make necessary computations on chalkboard	
	D. Antenna		
	II. Oscillator circuitry	Explain and discuss using bread-boarded circuit	
	A. Parts and nomenclature		
	B. Operation	Compute on chalkboard	
	C. Keying	Reading assignment	
	D. Stability factor	Drill on lesson	
	E. Power output	Oral questions	
	III. Amplifier circuitry	Test	
	A. Parts and nomenclature	Discussion	
	B. Operation		
	C. Input drive		
	D. Neutralization		
	E. Output power		
	F. Antenna coupling		
	G. Efficiency		
	Task Detail		
	1. Determine oscillator frequency	Demonstrate	Parts for assembly
	2. Assemble oscillator circuit		Suitable power supply
	3. Connect load		SWR bridge
	4. Check performance factors		VTVM and VOM
	a. Frequency		Oscilloscope
	b. Drift vs. time		Dummy antenna
	c. Shift with keying		Radio receiver
	d. Optimum power output		
	5. Assemble amplifier		243

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MINOR BLOCK "A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
R-F Transmitter (continued)	Task Detail (con't.) 6. Connect drive 7. Connect dummy load 8. Operate on reduced power 9. Tune for desired input 10. Tune output 11. Check for neutralization 12. Adjust if necessary 13. Increase to full power 14. Check for overheating 15. Check output a. For proper frequency b. For frequency drift c. For satisfactory keying d. For power	Discussion Task assignment Practice on task Oral questions Performance test	

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MAJOR BLOCK XI TRANSMISSION	TASK: 2. Match Transmitter To Dummy Load AIM: The student will be able to make use of dummy load to make transmitter adjustments.		
MINOR BLOCK A	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
R-F Transmitter	Related Knowledge		
	I. Uses for dummy load	Explanation	Ref. # 4
	II. Types of dummy loads	Illustration	
	III. Impedance matching	Reading assignment	
	IV. Power requirements	Drill on lesson	
	V. Limitations	Discussion	
	Task Detail		
	1. Connect dummy load	Demonstrate	Operating transmitter
	a. To transmitter		Suitable dummy load
	b. To SWR bridge		SWR bridge
	2. Power transmitter		Power measuring devices
	(Caution: High Voltage)	Discussion	
	3. Adjust transmitter	Task assignment	
	a. Resonance	Practice on task	
	b. Low power	Oral questions	
	4. Check SWR	Performance test	
	5. Optimize impedance match		
	6. Check power output		
	7. Check power input		
	8. Calculate efficiency		
	9. Remove power		

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MAJOR BLOCK XI TRANSMISSION	TASK: 3. A-M Modulate And R-F Amplifier AIM: The student will be able to select suitable circuit, assemble system and adjust.		
MINOR BLOCK A	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
R-F Transmitter	Related Knowledge		
	I. A-M principles	Discuss using:	Ref. # 4
	A. Analysis of A-M	Transparencies or chalkboard	
	B. Percentage of modulation	Reading assignment	
	C. Carrier shift	Drill on lesson	
	D. Distribution of power	Oral questions	
	II. A-M circuits	Test	
	A. Speech amplifier	Discussion	
	B. Modulator		
	C. Modulator stage		
	III. A-M methods		
	A. Plate modulation		
	B. Grid modulation		
	C. Other conventional methods		
	IV. Typical A-M transmitter		
	A. R-F circuits		
	B. A-F circuits		
	Task Detail		
	1. Excite and tune oscillator	Demonstrate	Basic C-W transmitter with antenna
	2. Check its frequency		
	3. Apply power to other stage(s)		Suitable modulator(s)
	4. Load into dummy load	Discussion	
	5. Compute power	Task assignment	
	6. Compute desired load impedance for modulator	Practice on task Performance test	
	7. Adjust modulator to match (Caution: High Voltage)		
	8. Connect modulator to R-F amplifier		
248	9. Couple oscilloscope to R-F output	249	

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
R-F Transmitter (continued)	Task Detail (con't.) 10. Modulate R-F stage with sine wave 11. Check for percent of clean modulation 12. Check "on-the-air" if licensed station and operator		

MAJOR BLOCK XI TRANSMISSION	TASK: 4. Locate And Correct R-F Transmitter Problems AIM: The student will be able to check malfunctioning conditions against diagrams and specifications to locate trouble and make repairs.		
MINOR BLOCK A	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
R-F Transmitter	Related Knowledge		
	I. Safety precautions	Discuss and list on chalkboard	Ref. # 4
	II. Dummy antennas	Describe with diagrams	
	III. Frequency measurements	Block diagrams on chalkboard	
	A. Calibrated receiver	Show computations	
	B. Absorption frequency meter	List and explain	
	C. Heterodyne frequency meter	Reading assignment	
	IV. Power measurement	Student led discussion	
	A. Input power	Drill on lesson	
	B. Radiated power	Oral questions	
	V. Modulation measurements	Test	
	A. Calibrated meter	Discussion	
	B. Oscilloscope		
	VI. Troubleshooting		
	A. Determine symptoms		
	B. Localizing trouble to an area		
	C. Isolating to a unit		
	D. Locating specific defect		
	Task Detail		
	1. Apply power	Demonstrate	
	2. Determine symptoms	Discussion	
	3. Analyze problems	Task assignment	
	4. Isolate inoperative portion	Practice on task	
	5. Locate specific defect	Oral questions	
	6. Make necessary correction	Performance test	
		Review	
		Examination	

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MAJOR BLOCK XI

TRANSMISSION

TASK: 1. Experiments In Wave Propagation

AIM: The student will be able to make more intelligent use of propagation factors.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Radio Waves	Related Knowledge		
	I. Propagation	Transparencies w/discussion	Ref. # 4
	II. Radiation and induction fields	Reading assignment	
	III. Polarization	Drill on lesson	
	IV. Ground-wave propagation	Oral questions	
	V. Sky-wave propagation	Test	
	VI. Scatter propagation	Discussion	
	Task Detail		
	1. Polarization	Demonstrate	Operating VHF transmitter, preferably 27-30 Meg Hz mobile or portable
	a. Move equipment to open space		Matching half-wave dipole
	b. Assemble dipole and indicator		Field strength meter or lamp indicator attached at center of dipole
	c. Energize transmitter		
	d. Turn dipole to frequency		
	e. Move away from transmitter until signal only modestly strong with both antennas parallel	Discussion	
		Task assignment	
	f. Note reading on indicator	Practice on task	
	g. Rotate dipole 90°	Oral questions	
	2. Ground wave and reflected waves	Performance test	
	a. Log six or more weak standard-broadcast stations	Explain experiment	Broadcast short wave, VHF, and UHF receivers
	(1) Mid-day		Map of United States
	(2) Sundown		Marking pens or tacks (4 colors)
	(3) Late bed-time		
	(4) Sunrise	Student assignments:	
	b. Locate on map and identify with a color for each of the above periods	One-half standard-broadcast	
		One-half short-wave VHF, UHF	
		Student report with maps	
	c. Repeat on several days	Discussion of results	

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Radio Waves (continued)	Task Detail (con't.) 3. Duplicate the above using short-wave, VHF and UHF receivers 4. Make comparisons 5. Record results	 Summary Oral questions Test on results of findings Discussion	

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MAJOR BLOCK XI TRANSMISSION	TASK: 2. Experiment Concerning Antenna Tuning AIM: The student will be able tc make use of electrical tuning information for operation of antenna system at maximum efficiency.		
MINOR BLOCK B	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Radio Waves	Related Knowledge		
	I. Wave length and frequency	Explain and compute examples	Ref. # 4
	II. Antenna length calculations	Calculate examples on chalkboard	
	III. Basic concepts	Reading assignment	
	A. Resistance	Drill on lesson	
	B. Impedance	Oral questions	
	C. Patterns	Test	
		Discussion	
		Field trip to Radio and/or TV station	
		Observe:	
		Antenna length(s)	
		Tuning system	
		Transmission line	
		Transmitter components	
		Control system	
		Discuss trip	
		Test on field trip	
	Task Detail		
	1. Space-wind 100 turns on cardboard tube	Demonstrate experiment	Radio with loop-stick antenna preferably battery operated
	a. String spaced		¼ #18 to #22 magnet wire
	b. Twist a top every 10 times		Cardboard tube 2½" to 3½" diameter
	c. Clean insulation off tops		365 mmf. tuning capacitor
	2. Connect coil		Mueller miniclip
	a. One end to ground		50" to 100" antenna w/ lead-in
	b. Mueller clip to antenna		
	c. Shunt capacitor between clip and ground		
	3. Tune in weak station	Discussion	
	4. Bring rear of set near coil	Task assignment	

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Radio Waves (continued)	Related Knowledge 5. Tune coil capacitor 6. Move clip, return capacitor 7. Note results 8. Repeat across B/C band 9. Make observations 10. Record results	Practice on task Oral questions Performance test	

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MAJOR BLOCK XI TRANSMISSION	TASK: 3. Adjust Match-Box For Minimum SWR AIM: The student will be able to connect and match transmission line to transmitter for optimum performance.		
MINOR BLOCK B	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Radio Waves	Related Knowledge		
	I. Definition	Define on chalkboard	Ref. # 7
	II. Characteristic impedance	Explain	
	III. Impedance calculations	Illustrate examples on chalkboard	
	IV. Standing waves	Reading assignment	
	A. Terminations	Drill on lesson	
	B. Standing-wave ratio	Oral questions	
	V. Uses of transmission line	Test	
	A. Method of feeding antenna	Discussion	
	B. Coupling transmitter to antenna		
	C. Matching sections		
	Task Detail		
	1. Connect "match box" on SWR bridge in place	Demonstrate	Operating 27-30 Meg. H_z transmitter
	2. Power transmitter on unused channel		Antenna-line "match box"
	3. Adjust "match box" for minimum SWR	Discussion Task assignment	SWR bridge
	4. Listen at intervals	Practice on task	
	5. Note results on SWR	Oral questions	
	6. Record extremes	Performance test	

MAJOR BLOCK XI

TRANSMISSION

TASK: 4. Construct And Tune Antenna To Frequency

AIM: The student will be able to design information to physically tune antenna for optimum performance.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Radio Waves	Related Knowledge		
	I. General types	List w/drawing on chalkboard	Ref. # 7
	II. High-frequency antennas	Explanation	
	A. Vertical	Illustration	
	B. Doublet	Reading assignment	
	C. "V" type	Drill on lesson	
	III. VHF and UHF	Oral questions	
	A. Vertical	Test	
	B. Directive half-wave	Discussion	
	C. Special types		
	Task Detail		
	1. Determine "center frequency"	Demonstrate	Operating transmitter
	2. Cut antenna longer than calculations indicate		Antenna construction materials
	3. Connect proper transmission live and SWR bridge		SWR bridge
	4. Listen on frequency	Discussion	
	5. Power transmitter	Task assignment	
	6. Check SWR	Practice on task	
	7. Reduce antenna length by small increments	Oral questions Performance test	
	8. Re-check SWR		
	9. Repeat to get minimum SWR	Review	
	10. Record	Examination	

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MAJOR BLOCK XII

CIRCUITRY AND INSTRUMENTATION

TASK: 1. Layout Breadboard Oscilloscope

AIM: The student will be able to layout a breadboard model of a complete oscilloscope.

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Oscilloscope Circuitry	Related Knowledge		
	I. Characteristics of CRT	Explanation with chalkboard	Ref. # 7
	A. Electronic gun	Student explanations	
	B. Deflection	Discussion	Ref. # 4
	C. Luminescence	Block diagram on chalkboard	
	II. Oscilloscope system	Explanation	
	A. CRT	Reading assignment	
	B. Power supply	Student-led discussions	
	C. Intensity control		
	D. Focusing		
	E. Centering		
	F. Horizontal sweep		
	G. Vertical amplifier		
	H. Synchronization		
	I. D-C sweeps		
		Oral questions	
		Test	
		Discussion	
	Task Detail		
	1. Arrange major parts	Demonstration of task	
	a. On paper	Discussion	
	b. Breadboard size	Task assignment	
	2. Allow for minor parts	Practice on task	
	3. Place controls for convenience	Oral questions	
	4. Sketch outline of major parts	Performance test	

MAJOR BLOCK XII CIRCUITRY AND INSTRUMENTATION	TASK: 2. Assemble And Wire Basic "CRT" Circuit AIM: The student will be able to properly connect and adjust values for proper operation of basic CRT circuit.		
MINOR BLOCK A	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Oscilloscope Circuitry	Related Knowledge		
	I. Power supply requirements	Explanation with illustrations	Ref. # 7
	II. Operation of power source(s)	Discussion	
	III. Voltage divider computations	Oral report assignment	
	IV. Electrical hazards	Student reports	
	V. Proper precautions	Test	
	VI. Basic CRT operation	Discussion	
	A. Heater		
	B. First anode		
	C. Focus		
	D. Second anode		
	E. Intensity control		
	F. Centering		
	Task Detail		
	1. Check parts against list	Demonstrate	Breadboard system
	2. Mount power supply parts		Basic oscilloscope parts to match CRT
	3. Mount CRT		
	4. Mount controls		VTVM
	5. Mount other parts		Variac or similar
	6. Connect basic circuitry	Transparency or chalkboard	
	7. Check operation	Discussion	
	8. Check voltages	Practice on task	
	9. Modify part values as may be necessary to maintain proper voltages	Oral questions Performance test	
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MAJOR BLOCK XII CIRCUITRY AND INSTRUMENTATION	TASK: 4. Connect Up CRT Vertical Amplifier AIM: The student will be able to evaluate vertical amplifier circuits, connect up, and test operation.		
MINOR BLOCK A	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Oscilloscope Circuitry	Related Knowledge		
	I. Purpose	Explanation	Ref. # 4
	II. Types	Illustrations	
	III. Frequency-range problems	Reading assignment	
	IV. Improving frequency-range	Student explanation	
	V. Special probes		
		Oral questions	
		Test	
		Discussion	
	Task Detail		
	1. Check amplifier parts list	Demonstrate	Suitable amplifier parts
	2. Test parts		VTVM or VOM
	3. Mount as required		Oscilloscope
	4. Connect wiring	Discussion	A-F generator
	5. Test amplifier	Task assignment	
	6. Wire into CRT circuit	Practice on task	
	7. Check operation	Oral questions	
	8. Check operational range	Performance test	
	9. Modify as necessary	Film:	Film: TF 11-2854, Fundamentals of Radio Troubleshooting, Part IV, Additional Techniques, U.S. Army
	10. Re-check and record on graph	Tell students what to look for in film	
		Show film	
		Discuss film	
		Test on film	
		Review	
		Examination	

MAJOR BLOCK XII CIRCUITRY AND INSTRUMENTATION	TASK: 3. Connect Up Horizontal Sweep Circuit AIM: The student will be able to design a sweep circuit to specifications, select parts, assemble and test.		
MINOR BLOCK A	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Oscilloscope Circuitry	Related Knowledge		
	I. Horizontal-deflection sources	Explanation	Ref. # 7
	A. 60 H_z sine-wave	Illustration	
	B. Internal sawtooth	Reading assignment	
	C. External signal	Student reports	
	II. Types of ramp generators	Oral questions	
	A. Critical design factors	Test	
	B. Modification of range	Discussion	
	III. Synchronization		
	IV. Sweep amplifier		
	V. Blanking		
	Task Detail		
	1. Select suitable components	Demonstrate	Sweep-circuit parts
	2. Temporarily connect		VTVM
	3. Check operation		Oscilloscope
	4. Modify for proper range		A-F generator
	5. Connect permanently	Discussion	
	6. Determine linearity and modify as necessary	Task assignment Practice on task	
	7. Check range	Oral questions Performance test	

MAJOR BLOCK XII CIRCUITRY AND INSTRUMENTATION	TASK: 1. Connect Integrated-Circuit Linear Amplifier AIM: The student will be able to properly select basic integrated circuit amplifier and put into a functioning circuit.		
MINOR BLOCK B	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Integrated Circuitry	Related Knowledge I. Historical development II. Physical aspects III. Common applications A. Amplifiers B. Signal generators IV. Configurations V. Methods of connecting VI. Electrical characteristics VII. Special problems in the use of IC's VIII. Relative cost: IC vs. discrete parts	Explanation Illustrations Chalkboard illustrations Reading assignment Discussion of circuitry Oral questions Test Discussion	Ref. # 4
	Task Detail 1. Wire IC into suitable power-amplifier circuitry and power supply 2. Measure Zero-signal D-C drain and record 3. Measure maximum-signal D-C current drain and power output and record 4. Measure input resistance and record 5. Measure frequency response and make graph	Demonstration Discussion Task assignment Practice on task Oral questions Performance test	

MAJOR BLOCK XII CIRCUITRY AND INSTRUMENTATION	TASK: 2. Connect Integrated-Circuit Oscillators AIM: The student will be able to select suitable oscillator circuit and construct assembly for specific use.		
MINOR BLOCK B	**INFORMATION & TASK DETAIL**	**SUGGESTIONS FOR TEACHING**	**REFERENCES & AIDS**
Integrated Circuitry	Related Knowledge		
	I. Types of oscillators A. Audio frequency B. Super-sonic frequency C. Radio frequency D. Square wave E. Ramp-function generators II. Functions III. Oscillator circuits IV. Operation of circuits	Explanation of various circuits Illustrations of circuits Reading assignment Discussion of lesson Oral questions Test	Ref. # 4
	Task Detail		
	1. Connect one-shot MV 2. Check and evaluate 3. Connect Schmitt trigger 4. Compare waveform with MV 5. Connect ramp-function generator 6. Check wave form 7. Graph all waveforms	Demonstration of task Discussion of circuits Task assignment Practice on task Oral questions Performance test	

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MAJOR BLOCK XII

CIRCUITRY AND INSTRUMENTATION

TASK: 3. Connect Experimental Basic Logic Circuits

AIM: The student will be able to determine proper components for use in basic logic circuits.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Integrated Circuitry	Related Knowledge		
	I. IC logic block	Explanations	Ref. # 4
	II. Logic building blocks	Definitions on chalkboard	
	III. Resistor-transistor logic	Logic circuits on chalkboard	
	IV. AND logic	Truth tables on chalkboard	
	V. OR logic	Reading assignment	
	VI. NOT logic	Drill on lesson	
	VII. NOR logic	Oral questions	
	VIII. NAND logic	Test	
	IX. Truth tables	Discussion	
	X. Binary arithmetic		
	Task Detail		
	1. Connect up basic logic block and record output from each	Demonstration of task Discussion of task	
	2. Connect sine wave to square wave pulse converter	Task assignment Practice on task	
	3. Check output of each block with oscilloscope	Oral questions Performance test	
	4. Record waveforms at all signal points	Review Examination	

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MAJOR BLOCK XII CIRCUITRY AND INSTRUMENTATION	TASK: 1. Check Characteristics Of Instrumentation Devices AIM: The student will be able to select suitable instrumentation device and put into an operating circuit.		
MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Instrumentation	Related Knowledge I. Relay functions II. Detectors A. Fire B. Radiation C. Sound D. Light E. Moisture III. Indicators A. Stroboscope B. Blinker C. Tachometer D. Meter E. Level IV. Bridge function	Explanation Circuit illustrations Reading assignments Student reports in class Oral questions Test Film: Tell students what to look for in film Show film Discuss film Test on film Discussion	Ref. # 4 Film: The Industrial Atom, U. S. Atomic Energy Commission Film: Industrial Applications of Radioisotopes, U. S. Atomic Energy Commission
	Task Detail 1. Connect, as many as feasible, suitable indicator control and devices 2. Check operation of each 3. Record for each: a. Purpose b. Characteristics c. Practical applications d. Circuit diagrams e. List of materials f. Sources of parts g. Cost of complete unit h. Operation principles	Demonstration using parts and materials to construct models (or apparatus) for controlling and indicating Discussion Student explanations of circuit operation Task assignments (individual or teams) Practice on tasks Student-led discussion of results Oral questions Performance test	

MAJOR BLOCK XII

CIRCUITRY AND INSTRUMENTATION

TASK: 2. Survey Devices For Timing And Switching Functions

AIM: The student will be able to select proper circuitry and assemble devices for timing and switching.

MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Instrumentation	Related Knowledge		
	I. Time delays	Explanation	Ref. # 4
	A. Mechanical	Circuit illustrations	
	B. Electro-mechanical	Discussion	
	C. Thermal	Student assignment	
	D. Electronic	Student reports	
	II. Timing circuits	Student-led discussion	
	A. Multivibrator		
	B. Oscillator		
	C. Wave shaping		
	1. Saw-tooth		
	2. Square		
	3. Pulse		
	III. Practical applications	Film:	Film: TF 11-3051, Transistors--Part VI--Transistors In Pulse Applications, U. S. Army
		Tell the student what to look for in film	
		Show film	
		Discuss film	
		Test on film	
		Oral questions	
		Test	
		Discussion	
	Task Detail		
	1. Connect(as feasible) various limited timing and wave-shaping circuits and/or devices	Demonstration using parts and materials to construct models (or apparatus) for timing and wave-shaping	
	2. Check operation of each	Student explanations of circuit operation	
	3. Record for each:	Task assignments (individual or teams)	
	a. Purpose		
	b. Characteristics		

MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Instrumentation (continued)	Task Detail (con't.) c. Practical application d. Circuit diagrams e. List of materials f. Sources of parts g. Cost of complete unit h. Operation principles	Practice on tasks Student-led discussion of results Oral questions Performance test	

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MAJOR BLOCK XII

CIRCUITRY AND INSTRUMENTATION

TASK: 3. Set Up Power Control Devices

AIM: The student will be able to select proper power control circuit and put into operation.

MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Instrumentation	Related Knowledge		
	I. Need for power controls	Explanation	Ref. # 4
	II. Methods	Circuit illustrations	
	A. Resistance	Reading assignments	
	B. Voltage	Student reports in class	
	C. Phase	Oral questions	
	D. Pulse	Test	
	E. Others	Discussion	
	III. Apparatus and characteristics		
	IV. Operation of circuitry		
	Task Detail		
	1. Set up various power control devices	Demonstration using parts and materials to construct models (or apparatus) for power control	
	2. Check operation of each	Discussion	
	3. Record for each:	Student explanation of circuitry	
	a. Purpose	Task assignments	
	b. Characteristics	Practice on task	
	c. Practical applications	Student-led discussion	
	d. Circuit diagrams	Oral questions	
	e. List of materials	Performance test	
	f. Sources of parts		
	g. Cost of unit		
	h. Operation of principles	Review	
		Examination	

MAJOR BLOCK XIII

COMPUTER TECHNOLOGY

TASK: 1. Historical Development

AIM: The student will be able to describe how the computer concept has evolved over the centuries.

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Computer Evolution	Related Knowledge I. Abacus A. 4,000 years ago B. Asian countries C. Fast adding D. Still used today II. Mechanical calculation A. 1617 - John Napier 1. Published paper 2. Led to development of slide rule later B. 1642 - Blaise Pascal 1. First real adding machine 2. Made with wheels and gears C. Late 1600's - Gottfried Leibnitz 1. Advanced calculator 2. Four functions plus square roots III. Punched cards A. Early 1800's - Joseph Jacquard 1. First punched cards 2. Loom instructions B. 1835 - Charles Babbage 1. Analytical engine 2. Mathematical computer 3. Punched card program 4. Conditional transfer loops 5. Principles still used today C. 1890's - Herman Hollerith 1. IBM card 2. Coded punching sequence 3. First electrical machine	Discussion Demonstrate Oral questions List on chalkboard Oral quiz	Ref. # 13 Walker, Roger S, Understanding Computer Science, Texas Instruments Learning Center, P. O. Box 225012 MS 54, 1981 Dallas, Texas 75265

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MAJOR BLOCK XIII COMPUTER TECHNOLOGY	TASK: 2. Electro-Mechanical To Electronic Computers AIM: The student will be able to describe how computers have evolved during this century.		
MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Computer Evolution	Related Knowledge I. Electro-mechanical A. 1944 - Howard Aiken 1. Harvard University 2. First electro-mechanical computer B. Mark I 1. 51 feet long - 8 feet high 2. Paper tape instructions 3. Punched card input 4. Typed card record 5. Three second multiplier C. 1947 - Mark II 1. 1/4 second multiplier 2. 12 times faster II. Electronic computers A. 1946 - ENIAC 1. University of Pennsylvania 2. Eckert and Mauchly 3. First electronic digital computer 4. Used vacuum tubes 5. 2.8 millisecond multiplier B. 1946 - Von Neumann 1. Parallel transfer idea 2. Stored program idea C. 1950 UNIVAC I 1. First mass-produced electronic computer 2. Same group as ENIAC 3. Vacuum tubes	Discussion Lecture Question List on chalkboard	Ref. # 2 Cannon, D. L., and Luecke, Gerald, Understanding Microprocessors, Texas Instruments Learning Center, P.O. Box 225012 MS-54, 1979 Dallas, Texas 75265

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Computer Evolution (continued)	Related Knowledge (con't.) D. Since 1950 1. 1958 - Jack Kilby, Texas Instruments - integrated circuit 2. 1971 One-chip calculator 3. 1972 4-bit micro computer on a chip 4. 1976 - 16-bit microprocessor 5. 1977 16-bit on a chip		

MAJOR BLOCK XIII COMPUTER TECHNOLOGY	TASK: 3. Software Development AIM: The student will be able to describe how computer software has evolved along with the hardware.		
MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Computer Evolution	Related Knowledge I. Define hardware and software II. Program III. Compilers and language IV. Memory A. Volatile (RAM) B. Nonvolatile (ROM) 1. Magnetic core 2. Bubble C. Internal D. Auxilliary E. Tapes F. Disks G. Punched cards	Discussion Display Question/answer	Ref. # 13 Computer tapes, disks, etc.

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MAJOR BLOCK XIII
COMPUTER TECHNOLOGY

TASK: 1. Computer Units And Their Functions
AIM: The student will be able to describe the primary units of a computer and relate their purpose.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Computer Design	Related Knowledge		
	I. Central Processing Unit (CPU)	List	Ref. # 13
	A. Makes decisions	Discuss	
	B. Controls other units	Diagram	
	C. Collects and decodes information	Question/answer	
	D. Communicates with input/output (I/O)		
	II. Memory		
	A. Stores instructions		
	B. Stores data		
	III. Input/Output Unit		
	A. Receives instruction		
	B. Communicates data to outside, memory, other systems, etc.		
	IV. Relay busses (16 wires)		
	A. Data bus		
	B. Address bus		
	C. Control bus		
	V. Accessory Units		
	A. Auxilliary storage	Summary	
	B. I/O processor	Quiz	

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MAJOR BLOCK XIII COMPUTER TECHNOLOGY	TASK: 2. Computer Terminology AIM: The student will be able to define computer terminology and explain relationships between computer functions.		
MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Computer Design	Related Knowledge		
	I. Review logic circuits and truth tables	Illustrate on chalkboard Discussion	Ref. # 2
	II. Metal-Oxide-Semiconductors (MOS)	Field trip	
	III. Chips	Demonstration	
	IV. Integrated digital circuitry		
	V. Binary digital signals		
	A. Single		
	B. Multiple		
	1. 4 bit - nibble		
	2. 8 bit - byte		
	3. 16 bit - word		
	VI. Instruction codes		
	VII. Address codes	Question/answer	
	VIII. Data codes	Summarize	
	IX. ASCII code	Oral quiz	

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MAJOR BLOCK XIII
COMPUTER TECHNOLOGY

TASK: 3. Memory Units
AIM: The student will be able to define types of memory units and describe their function.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Computer Design	Related Knowledge		
	I. NAND gate structure	Illustrate	Ref. # 2
	II. Flip-flop(static memory)	Discussion	
	A. R-S flip-flop		
	B. D(gate-latch) flip-flop		
	III. Dynamic memory cells (MDS)		
	IV. RAM's (Random access memory)		
	V. ROM (Read-only memory)	List	
	VI. PROM (Programmable read-only memory)	Oral questions	
	VII. EPROM (Erasable programmable read-only memory)		
	VIII. EAROM (Electrically alterable read-only memory)		
	IX. Arithmetic logic		
	A. Adder logic circuit		
	B. Register transfer circuit		
	X. Timing and control	Summarize	
		Quiz	

MAJOR BLOCK XIII COMPUTER TECHNOLOGY	TASK: 4. Computer Language AIM: The student will be able to define the more popular computer languages and describe their advantages and disadvantages.		
MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Computer Design	Related Knowledge		
	I. Conversing through codes	Discussion	Ref. # 3
	II. Interactive systems	Question/answer	
	III. Time sharing systems		
	IV. Expression evaluation		
	V. Subroutines	List	
	VI. BASIC		
	A. Development		
	B. Advantages		
	C. Disadvantages		
	VII. Pascal		
	A. Advantages		
	B. Disadvantages		
	VIII. FORTRAN		
	A. Advantages		
	B. Disadvantages		
	IX. PL/I		
	A. New language	Oral quiz	
	B. Advantages		
	Task Detail		
	Set up task as resources permit		
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MAJOR BLOCK XIII
COMPUTER TECHNOLOGY

TASK: 1. Program Development
AIM: The student will be able to describe the steps in developing a computer program.

MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Computer Operation	Related Knowledge		
	I. Program Considerations	List	Ref. # 13
	A. Cost	Discussion	
	B. Size		
	C. Storage requirements		
	D. Time		
	E. Flexibility and reliability		
	F. Maintenance		
	II. Steps in Programming	Explain	
	A. Define problem		
	1. Written description		
	2. List procedure		
	B. Develop flow chart	Illustrate on chalkboard	
	1. Bottom up		
	2. Top down		
	3. Flow chart symbols		
	C. Code program		
	1. Punched cards		
	2. Tape or disc		
	3. Language selection		
	4. Instructions		
	D. Translation		
	1. Mnemonics		
	2. Assembler		
	3. Compiler		
	E. Testing		
	1. Simple problem		
	2. Complex problem	Oral quiz	
	Task Detail		
	Set up task as resources permit		305

MAJOR BLOCK XIII COMPUTER TECHNOLOGY	TASK: 2. Overview of Operating Systems AIM: The student will be able to describe operating systems and their functions.		
MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Computer Operation	Related Knowledge		
	I. Purpose of operating system or monitor	Explanation	Ref. # 13
	II. Instructions to computer	List	
	A. Load and excute correct compiler	Discuss	
	B. Load machine instructions and begin		
	C. Direct final output to print or display		
	D. Terminate the job		
	III. Types of systems		
	A. For small computers		
	B. Large computers		
	1. Multiprogrammed		
	2. Time-sharing		
	3. Distributed processing		
	4. Resident monitor		
	5. Batch		
	IV. System managers		
	A. Job manager		
	1. Reads and places programs		
	2. Establishes control block		
	3. Checks priorities		
	4. Checks resources		
	5. Assigns resources		
	6. Executes job		
	B. Memory manager		
	1. Stores information		
	2. Retrieves information		

MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Computer Operation (continued)	Related Knowledge (con't.) C. Processor manager 1. Assigns tasks to CPU 2. Synchronizes steps D. I/O manager 1. Maintains resource tables 2. Accepts input 3. Controls output E. Information manager 1. Stores data 2. Locates and retrieves data Task Detail Set up task as resources permit	Summarize Quiz	

MAJOR BLOCK XIV OPTRONICS	TASK: 1. Determine Physical Aspects of Light AIM: The student will be able to define light as a form of energy.

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Radiation Detection	Related Knowledge I. Solar energy II. Photon radiation III. Wavelength and frequency A. X-rays B. Invisible light C. Visible light IV. Color V. Light measurement A. Photometric system B. Radiometric system VI. Artificial light A. Incandescent B. Gas discharge 1. Fluorescent 2. Neon 3. Xenon VII. Optoelectronics A. Injection luminescence 1. VLED 2. LED 3. Liquid crystal display B. Stimulated emission 1. Maser - 1954 2. Laser - 1960 VIII. Considerations in source selection A. Wavelength distribution B. Viewing angle C. Power efficiency Task Detail Set up task as resources permit	Discussion Illustrate Oral questions	Masten, Larry B. and Billy R. Understanding Optronics, Texas Instruments Learning Center, P.O. Box 225012 MS 54, Dallas, Texas 75265, 1981.

MAJOR BLOCK XIV
OPTRONICS

TASK: 2. Select Light Detector for Specific Job
AIM: The student will be able to name several types of light detectors and describe their functions.

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Radiation Detection	Related Knowledge		
	I. Thermal detectors	Discussion	Ref. # 9
	A. Thomson emf		
	B. Peltier emf		
	C. Seebeck emf		
	II. Semiconductor review		
	A. P-type		
	B. N-type		
	III. Quantum detectors	Demonstrate	
	A. Photoresistive		
	B. Photovoltaic		
	C. Photoemissive		
	IV. Detector characteristics		
	A. Spectral response		
	B. Viewing angle		
	C. Efficiency		
	D. Electrical properties	Oral quiz	
	Task Detail		
	Set up task as resources permit		

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MAJOR BLOCK XIV OPTRONICS	TASK: 3. Optically Couple Light Sources and Detectors AIM: The student will be able to describe how electronic systems are optically coupled.		
MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Radiation Detection	Related Knowledge I. Purpose of optical coupling A. Obtain information B. Transfer information C. Solve problems II. Kinds of systems A. Interruptive 1. Door openers 2. Burglar alarms 3. Bar code readers B. Non-interruptive 1. Computer communication 2. Electrical isolation III. Components A. Light sources 1. Sun 2. Lamps 3. Light emitting diodes 4. Others B. Detector 1. Eye 2. Silicon semiconductor 3. Others C. Transfer media 1. Air 2. Electrical insulation 3. Windows 4. Lens 5. Filters 6. Mirrors 7. Prisms 8. Diffraction	Discussion Demonstration	Ref. # 9

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Radiation Detection (continued)	Related Knowledge (con't.) 9. Fiber optics IV. Important considerations A. Proper matching B. Transfer ratio C. Frequency response D. Isolation E. Noise immunity Task Detail Set up task as resources permit		

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MAJOR BLOCK XIV OPTRONICS	TASK: 4. Describe Optoelectronic Methods of Visual Communication AIM: The student will be able to describe the various types of electronic displays used to convey information.		
MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Radiation Detection	Related Knowledge I. Display characteristics A. Viewability B. Response time C. Power requirement D. Reliability E. Shock resistance II. Display types A. Indicators 1. Single lamp 2. VLED B. Semiconductor numeric 1. Discrete VLED array 2. Seven segment C. Semiconductor alphanumeric 1. 35 VLED 2. ASCII code D. Liquid crystal 1. Advantages 2. Disadvantages E. Gas discharge 1. Operation 2. Advantages 3. Disadvantages F. Vacuum fluorescent 1. Operation 2. Advantages 3. Disadvantages G. Electroluminescent 1. Operation 2. Advantages 3. Disadvantages	Discussion Demonstrate	Ref. # 9

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Radiation Detection (continued)	Related Knowledge (con't.) H. AC plasma 1. Operation 2. Advantages 3. Disadvantages I. Calhode ray tube 1. Operation 2. Advantages 3. Disadvantages J. Ink jet printer 1. Operation 2. Uses III. Applications Task Detail Set up task as resources permit	Quiz	

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MAJOR BLOCK XIV
OPTRONICS

TASK: 1. Develop Display Using Visible Light Emitting Diodes
AIM: The student will be able to describe and use light emitting diodes in displays.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Applications	Related Knowledge		
	I. VLE electro-optical characteristics	Discussion	Ref. # 9
	II. Optical characteristics	List	
	III. Electrical characteristics		Manufacturer's data sheets
	IV. Selection		
	V. Applications	Demonstration	
	A. Indicators		
	1. Status		
	2. Logic level		
	3. Instrument panels		
	B. Other		
	1. Illumination		
	2. Remote controls	Summarize	
	3. Voltage monitors	Quiz	
	Task Detail		
	Set up task as resources permit		

MAJOR BLOCK XIV OPTRONICS	TASK: 2. Make Application of Photodetectors AIM: The student will be able to describe and use photodetectors.		
MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Applications	Related Knowledge I. Photodiode characteristcis A. Electro-optical 1. Quantum efficiency 2. Flux responsivity 3. Specific response 4. Photocurrent versus irradiance 5. Incidence response 6. Directional sensitivity B. Electrical 1. Breakdown voltage 2. Current leakage 3. Capacitance 4. Frequency response 5. Power dissipation II. Phototransistor characteristics A. Electro-optical 1. Advantage 2. Disadvantage B. Optical 1. Spectral response 2. Directional sensitivity C. Electrical 1. Dark current 2. Collector current 3. Power dissipation 4. Amplification factor III. Other photodetectors A. Photo field effect transistor 1. Review MOS 2. Operation	Discussion List on chalkboard	Ref. # 9 Manufacturer's data sheets

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Applications (continued)	Related Knowledge (con't.) 3. Advantages 4. Disadvantages B. Avalanche photodiode reference diode combinations 1. Advantages 2. Disadvantages C. Photothyristors 1. Operation 2. Advantages IV. Applications A. Photography 1. Light meter 2. Flash control 3. Headlight dimmer 4. Others Task Detail Set up task as resources permit	Summarize Oral quiz	

MAJOR BLOCK XIV
OPTRONICS

TASK: 3. Photocoupled Data Acquisition Systems
AIM: The student will be able to discuss various photocoupled data acquisition systems and describe their applications.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Applications	Related Knowledge		
	I. Information acquired	Discussion	Ref. # 9
	A. Object detection		
	B. Speed of travel		
	C. Color	List	
	D. Reflectivity		
	E. Transparency	Illustrate	
	F. Distance		
	II. Transmissive system uses		
	A. Punched card readers		
	B. Sensors		
	1. Position		
	2. Speed		
	3. Fluid level		
	C. Brushless motors		
	D. Ignition systems		
	III. Reflective system uses		
	A. Bar code readers		
	1. Handheld		
	2. Laser		
	B. Range finders		
	1. Light intensity type		
	2. Reflected infrared		
	C. Guidance		
	1. Missles		
	2. Aircraft		
	3. Other	Summarize	
	Task Detail		
	Set up task as resources permit		

MAJOR BLOCK XIV
OPTRONICS

TASK: 4. Photocoupled Data Transmission Media
AIM: The student will be able to discuss light transmission media used in photocoupled systems.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Applications	Related Knowledge		
	I. Air transmission	Discussion	Ref. # 9
	A. Advantages		
	B. Disadvantages		
	C. Infrared remote control	Illustrations	
	1. Components		
	2. Operation		
	D. Wireless audio		
	1. Components		
	2. Operation		
	II. Transparent media	Demonstration	
	A. Photocoupler		
	1. Components		
	2. Operation		
	B. Opto-isolators		
	1. Components		
	2. Applications		
	a. Medical		
	b. Adding voltages		
	c. Chopper circuit		
	d. Industry		
	III. Fiber optics		
	A. Optic principles		
	1. Light reflection		
	2. Index of Refraction		
	3. Snell's Law		
	B. Fiber construction		
	1. Size		
	2. Types		
	3. Characteristics		

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MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Applications (continued)	Related Knowledge (con't.) C. Transmission techniques 1. Light sources 2. System components 3. Operation D. Advantages E. Disadvantages Task Detail Set up task as resources permit	Summarize Quiz	

MAJOR BLOCK XIV OPTRONICS	TASK: 5. Laser Types and Uses AIM: The student will be able to discuss the operating principles of various types of lasers and describe their applications.		
MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Applications	Related Knowledge		
	I. LASER and MASER defined	Discussion	Ref. # 9
	II. Coherence		
	A. Temporal		
	B. Spatial	Define	
	III. Dangers		
	IV. Theory of operation		
	A. Energy levels		
	B. Pumping		
	C. Three level laser		
	D. Four level laser		
	V. Laser types		
	A. Solid-state		
	B. Gas		
	C. Semiconductor		
	D. Liquid		
	VI. Maser types		
	A. Ammonia		
	B. Ruby		
	VII. Laser uses	List	
	A. Distance measure	Describe	
	B. Tracking systems		
	C. Medical		
	D. Industrial	Illustrate	
	E. Communication		
	F. Printing		
	G. Hologram production		
	H. Video disks		
	I. Product analysis	Summary	
	J. Others	Quiz	
	Task Detail		
	Set up task as resources permit		

MAJOR BLOCK XV THE BUSINESS OF ELECTRONICS	TASK: 1. Define (Describe) Free Enterprise AIM: The student will be able to define (describe) our economic system and compare it with other major economic systems. The student will further be able to explain the basis of our economy, list the primary factors of production, and identify the important groups in our economic system.

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Free Enterprise	Related Knowledge		
	I. The rise of economic systems A. Dawn of civilization B. Discovery of tools C. Specialization/division of labor D. Industrialization E. Trade development	Reading assignment Discuss: History and background that gave rise to economic systems	Sup. Ref. D., Woodburn, Clint H., An Introduction to Vocational Industrial Education, Vocational Instructional Services, Texas A&M Univ., F.E. Box 182, College Station, TX 77843
	II. Standard of living A. How well off people of a society are B. Synonymous with "economy" C. Measured by dividing total production by population	Define: Standard of living; how it is measured	Sup. Ref. B., Fundamentals of The American Free Enterprise System, Hodgetts, R. M., and Smart, T. L., Addison - Wesley Publishing Co., Inc., Menlo Park, CA 94025
	III. Factors of production A. Land (resources) B. Labor (people) C. Capital (money invested) D. Technology (education; know-how)	Point out: Factors of production	
	IV. Basic questions every economic system must answer A. What goods and services are to be produced? B. Who shall produce them? C. How shall they be produced? D. For whom shall they be produced?	List: On chalkboard	
	V. Basis of free enterprise A. Private property B. Private enterprise C. Freedom of choice	Expound: On each	

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Free Enterprise (continued)	Related Knowledge (con't.) VI. Major types of economic systems today A. Pure capitalism B. Modified capitalism C. Socialism D. Communism VII. Pure capitalism A. Exists in theory only B. Individuals afforded liberties basic to free enterprise 1. People determine kinds of goods and services 2. No government control VIII. Modified capitalism A. Laws regulate business activities to protect the people 1. Economic freedoms stated 2. Prevents monopolies B. Public determines product (supply and demand) C. Promotes finding better way (new products) D. Stresses importance of individual 1. Occupational choice 2. Personal incentive 3. Private ownership E. Competition controls quality; price IX. Socialism A. Government controls major industries 1. Transportation	Lecture: Major economic systems Students take notes Explain: Laws protect the people; limited natural resources Compare: Major economic systems	

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Free Enterprise (continued)	Related Knowledge (con't.) 2. Communication 3. Power and utilities B. Secondary industry permitted to remain in private ownership C. Secondary dependent on major: hence government controls 1. Prices 2. Wages		
	X. Communism A. Production of goods and services in hands of government 1. Government owns everything 2. Government decides all aspects of business and production 3. Private business non-existent	Recite: Examples of "Have" and "Have Not" economies; reasons for	
	B. Promotes communism itself 1. No individual choice or freedom 2. No incentive; wastes individual talent 3. Stresses conformity; all rely on government	Emphasize: Advantages of capitalistic economy	
	XI. Important groups in a capitalistic society A. Entrepreneurs - planners, organizers B. Managers - overseers C. Workers - produce goods/services D. Consumers - utilize goods/services	Explore: Part each plays; how they are interdependent Review: Questions and answers	

MAJOR BLOCK XV
THE BUSINESS OF ELECTRONICS

TASK: 2. Identify Various Forms Of Business Ownership
AIM: The student will be able to identify and describe the different forms of business ownership actively engaged within the free enterprise system.

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Free Enterprise	Related Knowledge		
	I. Sole proprietorship	Reading assignment	Sup. Ref. B
	A. Owned and controlled by one individual		
	B. Most common form of business ownership in America (75%)		Sup. Ref. E., Wright R. Thomas, Manufacturing Material Processing, Management, Careers, The Goodheart-Willcox Co., Inc., Homewood, IL 60430
	C. Mostly small-medium sized		
	D. Advantages		
	1. Fewer restrictions on starting/terminating venture		
	2. Sole decision maker		
	3. Easier to manage		
	4. All profits belong to owner		
	5. Simpler tax structure	Students take notes	
	6. Higher credit standing		
	II. Partnerships		
	A. General partners		
	1. Have equal and unlimited liability		
	2. All partners active in firms operation		
	B. Limited partners	Recite: Examples of each form in the community; state	
	1. One dominant partner assumes unlimited liability; is the decision maker		
	2. Other limit liability to amount to money they invest		

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MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Free Enterprise (continued)	Related Knowledge (con't.) C. Silent partner 1. Known as a partner 2. Takes no active part in management D. Nominal partner 1. Lends name to venture 2. Makes no investment nor assists in operation E. Advantages of partnership 1. Increased source of capital and credit 2. Improved decision making potential 3. Better possibilities for expansion and growth III. Joint venture A. Partnership created for particular purpose B. Partnership dissolved when objective is accomplished C. Advantages 1. Increases power of bidding and acquiring contracts 2. Increases power to fulfill contracts IV. Syndicates A. Resemble both general partnership and joint venture B. Organized to conduct financial transactions C. Advantages 1. Increases buying power 2. Beneficial to small business with mutual needs		345

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Free Enterprise (continued)	Related Knowledge (con't.) V. Unincorporated associations A. Most often used by nonprofit organizations B. Exist to provide services to members C. Annual dues; fees levied membership for financing D. Examples 1. Credit associations 2. Fraternal organizations 3. Charities VI. Corporations A. Usually outgrowth of other forms of ownership B. Largest of all forms of ownership C. Multi-owners called stock-holders D. Regarded as an artificial being with 1. Right to enter contracts 2. Conduct business in own name E. Must file for and receive corporate charter to do business F. Charter defines: 1. Type of business 2. Number of shares of stock 3. Basis of corporate structure G. Corporate organization 1. Stockholders (owners) 2. Board of directors (policy makers)		

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MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Free Enterprise (continued)	Related Knowledge (con't.) 3. President (head) 4. Corporate officers (division heads) 5. Managers 6. Supervisors 7. Workers H. Advantages 1. Indefinite life 2. Limited liability 3. Ease of ownership transfer 4. Growth potential 5. Managerial efficiency Task Details 1. Design a questionnaire in preparation of interviewing owners of local businesses 2. Select and interview a local business owner 3. Compare results of interviews in class	Guest speaker: "Free Enterprise" Questions and answer session	Guest speaker: Civic leader 349

MAJOR BLOCK XV
THE BUSINESS OF ELECTRONICS

TASK: 3. Entrepreneurship And Electronics Technology
AIM: The student will be able to describe entrepreneurship; identify many risks and responsibilities in starting a business; and weigh the advantages/disadvantages of business ownership.

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Free Enterprise	Related Knowledge		
	I. Facts about entrepreneurship in U.S.	Reading assignment	Sup. Ref. E
	A. One of every eight persons on labor force is self-employed	Explain: Role small business plays in American economy	
	B. 10.8 million of country's 88 million labor force are single owners small businesses		
	C. 87% of total business operations are small	Place: Statistics on chalkboard	
	1. Over 10 million have annual sales under $100,000.00		
	2. 7½ million single-owner businesses show receipts less than $25,000		
	II. Personal traits characteristic entrepreneurs	Have students reflect on qualities admired in their employer	Sup. Ref. C., "Development of Professional Attitudes", Vocational Instructional Services, Texas A&M University, F.E. Box 182, College Station, TX 77843
	A. Passion to achieve		
	1. Pride of achievement		
	2. Leave personal, lasting mark		
	3. Make name for self		
	4. Aspire to fame		
	B. Urge to be boss		Sup. Ref. A., Starting Your Own Marketing Business, 2nd Ed., Ely and Barnes, McGraw-Hill Book Co., 2121 Ave. of Americas, New York, N.Y. 10020
	1. Independence motivation stronger than security		
	2. Desire to plot own course		
	C. Self-confidence		
	1. Expects and desires role of decision maker		

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MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Free Enterprise (continued)	Related Knowledge (con't.) 2. Delights in facing problems and making decisions D. Energy (physical stamina) E. Determination F. Versatility and adaptability III. Advantages of entrepreneurship A. Fills important basic needs to 1. Achieve 2. Meet challenge; make decisions 3. Demonstrate creativity; individuality B. Opportunity to develop close relationship with: 1. Customers 2. Employees C. Pride and prestige of ownership D. Unlimited financial growth potential IV. Disadvantages of entrepreneurship A. Long work hours B. Risk of financial loss C. Burdens often heavy on family D. Contend with confines of regulatory agencies V. Necessary skills of the entrepreneur A. Ability to plan - set goals B. Ability to organize - means of attaining goals C. Ability to control - cause people to do things productively	Class discussion: Advantages; disadvantages (instructor guide discussion) List: Advantages/disadvantages on chalkboard Guest speaker Discuss: Necessary skills of an entrepreneur	Guest speaker: local electronic shop owner

MINOR BLOCK A	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Free Enterprise (continued)	Related Knowledge (con't.) VI. Role of electronic technician A. Industry 1. Computer assisted design (CAD) 2. Computer assisted manufacturing (CAM) 3. Robotics 4. Quality control 5. Others B. Communications C. Office systems D. Education E. Medicine F. Aerospace G. General public 1. Sales 2. Installations 3. Repair service	Explain: Role in today's economy	

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MAJOR BLOCK XV THE BUSINESS OF ELECTRONICS	TASK: 1. Business Potential AIM: The student will be able to identify and discuss many of the elements involved in investigating and planning a prospective business.		
MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Management Technology	Related Knowledge I. Elements of entrepreneurship A. Planning-setting goals B. Organizing-structuring C. Controlling-directing II. Determine product and market A. Define product service B. Evaluate business potential 1. Present 2. Future C. Establish limits extent of business III. Identify essentials for production A. Equipment B. Materials C. Facility D. Skills IV. Estimate financial needs A. Capital outlay B. 1. Building 2. Equipment 3. Materials B. Operating capital 1. Overhead 2. Payroll C. Cash-flow considerations 1. Outflow-capital output, inventory, salaries 2. Inflow-payment of goods and services	Reading assignment Lecture: Procedures for investigating a potential business Discuss: Essentials for production List: On chalkboard criteria for estimating financial needs	Sup. Ref. B Sup. Ref. A

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Management Technology (continued)	Related Knowledge (con't.)		
	V. Starting part-time	Guest speaker: "Getting started in business"	Guest speaker: local electronic shop owner
	A. Advantages		
	1. Provides practical experience		
	2. Useful in building up trade; reputation		
	3. Little overhead; less financial risk		
	4. Allows more competitive pricing	Question and answer session	
	B. Disadvantages		
	1. Long hours		
	2. May affect regular job competency		
	3. May compete with employer	Review	

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MAJOR BLOCK XV

THE BUSINESS OF ELECTRONICS

TASK: 2. Business Facility

AIM: The student will be able to evaluate physical facilities objectively keeping in mind the needs of a potential business.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Management Technology	Related Knowledge		
	I. Building	Review: Blueprint reading	
	A. Size and shape		
	1. Floor plan		
	2. Area - square footage		
	3. Overhead clearances		
	B. Type space		
	1. Office space		
	2. Shop area		
	3. Warehouse; storage		
	II. Utilities		
	A. Types		
	B. Location		
	C. Availability		
	1. Relocate		
	2. Additional		
	III. Grounds		
	A. Size and shape		
	B. Topography		
	1. Surfacing; drainage		
	2. Fences		
	3. Obstructions		
	C. Parking, pick-up and delivery	Encourage: Class participation in planning physical needs of new business	
	1. Customer; employee		
	2. Entrances, drives, exits		
	3. Outside storage yard		
	IV. Facility condition	Oral questions	
	A. Repair; maintenance		
	1. Building		
	2. Grounds		
	B. Potential		

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Management Technology (continued)	Related Knowledge (con't.) 1. Modification 2. Growth V. Location A. Legal restrictions 1. City ordinances 2. Zoning codes B. Accessibility 1. Major thoroughfares 2. Access roads C. Environment 1. Surrounding business; industry 2. Potential clientele VI. Buying vs leasing A. Lease/rent advantages 1. Less capital investment 2. Less lost if business fails 3. Easier to relocate B. Lease/rent disadvantages 1. Rent may go up each new contract 2. Rent paid is money gone forever 3. Getting owner to make repairs, modifications often difficult 4. Property ownership may change C. Buying/building advantages 1. Planning facility may be more acute 2. Capital outlay usually sound investment 3. Finance notes realize some return	List: On chalkboard - items to to investigate when looking for a potential business facility Discuss: Advantages/disadvantages of buying; leasing	

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MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Management Technology (continued)	Related Knowledge (con't) 4. Pride of ownership D. Buying/building disadvantages 1. Cost may be prohibitive for founding business 2. Owner bears cost of all maintenance; repair 3. Insurance cost a consideration 4. Greater loss if business folds VII. Selection of capital equipment A. Purpose and function B. Type, brand, and special features C. Cost analysis 1. Purchase - payout 2. Rent, lease VIII. Placement of capital equipment A. Conducive to production 1. Labor saving steps 2. Production method 3. Economics B. Conducive to safety 1. Safety aisles 2. Operating clearances 3. Safety guards IX. Tools and equipment A. Selection 1. Essential to business 2. Comparative value B. Storage 1. Centrally located 2. Safety considerations X. Materials and supplies	Discuss: Equipment specifications, methods of writing specifications, purchase orders	Dealer's catalogs and brochures

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Management Technology (continued)	Related Knowledge (con't.) A. Economics 1. Buying in bulk 2. Storage facilities B. Selection 1. Comparative value 2. Items consumed in quantity C. Inventory 1. Quantity 2. Quality; description Task Detail 1. Write specifications for equipment	Review:	

MAJOR BLOCK XV THE BUSINESS OF ELECTRONICS	TASK: 3. Loans, Finance, And Credit AIM: The student will be able to define secured and unsecured loan, collateral and lines of credit. The student will also be capable of properly writing a personal check and balancing a personal checking account.		
MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Management Technology	Related Knowledge		
	I. Types of loans	Reading assignment	Sup. Ref. A
	A. Unsecured loan		
	1. Promissory note		
	2. Called signature loan		
	3. Requires no collateral	Define: Unsecured loan, secured loan	
	B. Secured loan		
	1. Formally written		
	2. Specifies terms; interest		
	3. Requires collateral		
	II. Sources of loans	List: Sources of loans	
	A. Personal savings		
	B. Family; friends		
	C. Banks; trust companies		
	D. Credit unions		
	E. Government		
	III. Forms of collateral	Define: Collateral	
	A. Real estate	List: Examples	
	B. Insurance policies		
	C. Pledge company assets		
	IV. Lines of credit	Discuss: Credit; importance of "good credit"; honesty; integrity	
	A. Personal reputation		
	1. Honesty		
	2. Integrity		
	B. Credit ratings		
	1. Better Business Bureau		
	2. Banks		
	3. Charge accounts		
	V. Terms and interest	Explain: Simple interest	
	A. Terms - condition of loan	Compound interest	
	1. Amount of loan	Principal	
	2. Length of loan	Unpaid balance	

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Management Technology (continued)	Related Knowledge (con't.) 3. Interest rate charged 4. How loan is to be repaid 5. Guarantees B. Interest - charge for loan 1. Simple 2. Compound 3. Principal 4. Unpaid balance VI. Banking A. Accounts 1. Checking account 2. Passbook savings 3. Certificates of saving B. Balancing books 1. Deposits 2. Withdrawals 3. Service charges C. Writing checks	Illustrate: On chalkboard Guest speaker: "Personal Banking" Review	Guest speaker: local banker

MAJOR BLOCK XV THE BUSINESS OF ELECTRONICS	TASK: 4. Bookkeeping And Accounting AIM: The student will be able to recite the basic needs for accurate bookkeeping and list many other uses of an accurate set of books.

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Management Technology	Related Knowledge		
	I. Basic needs for accounts and bookkeeping	Explain: I. R. S. assumption that all income is profit unless otherwise proven	
	A. Indicator of profit or loss		
	B. Satisfy I. R. S.		
	II. Other uses	List: On chalkboard	
	A. Record of profit/loss		
	B. Determine cost of each job; jobs in progress		
	C. Forecast cashflow needs	Discuss: Uses	
	D. Guide in cost estimating		
	E. Used in determining net worth of business		
	F. Reports; federal and state authorities		
	III. Accounting terminology	Define: Accounting terms	
	A. Voucher system		
	B. Single and double entry		
	C. Credit and debit		
	D. Assets and liabilities		
	E. Balanced books		
	F. Purchase orders		
	IV. Expense and receipts		
	A. Expense account		
	1. Company outflow		
	2. Total cost of operating		
	B. Receipts account		
	1. Receipts for bank deposits or . . .		
	2. Receipts given to customers		

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Management Technology (continued)	Related Knowledge (con't.) V. Use of journals and ledgers A. Keep individual accounts 1. Journal - running account (permanent) 2. Ledgers - one job (temporary) 3. Equipment costs B. Method of double entry bookkeeping 1. A way to verify charges 2. Used spot mischarges 3. Used in itemizing materials; labor in customer billing VI. Profit and loss statement A. Shows expenditures and receipts for certain period B. Yearly total show taxable income-profit VII. Overhead A. What comprises overhead 1. Cost of facility 2. Utilities 3. Transportation and delivery 4. Taxes 5. Insurance B. Methods of charging overhead 1. Percentage of total cost of operation formulated 2. Distribution of overhead as related to each job VIII. Depreciation A. Straight-line depreciation B. Declining-balance depreciation	Explain: Difference in journals and ledgers; how they serve as double entry method of bookkeeping Students take notes Discuss: Overhead List: Items that comprise overhead Explain: Depreciation; what may be depreciated; methods of depreciation	

MINOR BLOCK B	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Management Technology (continued)	Related Knowledge (con't.) C. Sum-of-the-digits method D. Unit-of-production method IX. Payrolls A. Statutory requirements 1. Social security deductions a. Employees' portion b. Employer's portion 2. Withholding tax (income tax) 3. Unemployment compensation 4. Worker's compensation insurance B. Fringe benefits 1. To an employer - all payments other than hourly rate 2. To labor union - payments not required by law a. Vacation b. Retirement 3. Fringes paid to a trust generally expressed as cents per hour a. Sick leave b. Retirement c. Vacation C. Payroll journals 1. Employee name and number 2. Hours worked 3. Total earnings 4. Deductions 5. Date and check number	Guest speaker: "A need for accurate books" Review Test	Guest speaker: representative of I. R. S. local C. P. A. 377

MAJOR BLOCK XV

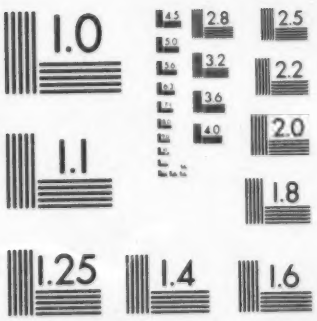
THE BUSINESS OF ELECTRONICS

TASK: 1. Cost Estimating

AIM: The student will be able to explain the methods by which electronic shop owners arrive at prices for contract proposals. The student will further be able to make simple quantity take-off in preparation of such a proposal.

MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Production Technology	Related Knowledge I. Definition A. A means used to evaluate B. To fix a cost in an approximate manner II. Purpose A. Establish an accurate approximate cost before production B. Usually for the purpose of bidding on and obtaining contracts III. Other uses of good estimating A. Material take-off used to order material as needed B. Time estimates for preparing job schedules C. Schedules forecast: 1. Number of workers 2. Skills required 3. Where and when special equipment needed 4. Material delivery at site IV. Traits of a good estimator A. Meticulous 1. Observant 2. Persistent B. Neat and orderly 1. Detailed 2. Progressive	Lecture: Purpose; importance of good estimating List: On chalkboard Students take notes Discuss: Qualities, prerequisites	

MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Production Technology (continued)	Related Knowledge (con't.)		
	V. Prerequisites of a good estimator	Guest speaker: "Cost estimating"	Guest speaker
	A. Ability to visualize:		
	1. Finished product		
	2. Steps necessary in performing job		
	3. Number of workers, skills, time required		
	4. Equipment and materials needed		
	5. Hidden items such as permits, bonds, taxes		
	B. Read and interpret schematics and specifications	Review: Schematic reading	
	1. Dimension		
	2. Symbols		
	C. Mathematical ability	Review: Related math	
	1. Computational skills		
	2. Tabulation accuracy		
	D. Knowledge of materials and prices		
	1. Types of components and their uses	Dealer's catalogs	
	2. Prices of components		
	3. Availability		
	E. Experience in the field which he/she is estimating		
	1. Skills necessary		
	2. Procedures, techniques currently used		
	3. Time required		
	4. Special equipment necessary		
	VI. Major phases of estimating		381
	A. Component take-off		



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STANDARD REFERENCE MATERIAL 1010a
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MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Production Technology (continued)	Related Knowledge (con't.) 1. Type 2. Quantity 3. Unit; total price B. Labor pricing 1. Number of technicians 2. Skills required 3. Work hours (time) VII. Types of cost estimating A. Volume method 1. Some components sold by volume 2. Some contracts based on volumes 3. Based on unit cost to supply/move construct B. Guesstimate 1. Based on personal experience 2. Usually in a local, well-known area 3. Usually small jobs/ contracts on regular basis C. Detailed quantity take-off 1. Detailed item by item breakdown of a. Components b. Labor c. Time 2. Cost analysis of hidden items not clearly evident in plans and specifications a. Permits and bonds b. Special equipment machines c. Operating overhead	Explain: Methods of cost estimating; how methods vary according to job Recite: Examples Pass out: Assignment sheet Emphasize: Importance of identifying hidden cost	Assignment sheet (teacher prepared) drawings and specifications

MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Production Technology (continued)	Related Knowledge (con't.) 3. Most used type building and construction D. Unit cost estimate 1. Prototype developed 2. Cost analysis made 3. Standard units produced	Point Out: This method most used in the electronics business	

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MAJOR BLOCK XV

THE BUSINESS OF ELECTRONICS

TASK: 2. Contracts

AIM: The student will be able to list the ingredients of a contract and explain what constitutes a valid contract, invalid contract, and breach of contract.

MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Production Technology	Related Knowledge		
	I. The American Legal System	Lecture:	Sup. Ref. B
	A. Constitution basis		
	1. Defines laws "rules of the game" within which individuals; businesses must operate	Discuss: History and background of the American Legal System	
	2. Establishes system by which these laws are governed		
	B. Two main sources of law	Describe: The two main sources of law in the United States	
	1. Statutory law (written law) enactments of government		
	2. Common law (unwritten law) based on court decisions		
	II. Nature of business law	Explain: The nature of business law in the United States	
	A. Provides orderly conduct of business affairs		
	B. Provides settlement of any disputes arising from these affairs		
	C. Contract law is one of the most important areas of business law	Guest speaker: "Contracts"	Guest speaker: City attorney, lawyer
	D. Everyone, every business, enters into contracts of some sort	Question and answer session	
	III. Ingredients of a contract	List: Ingredients of a contract	
	A. Voluntary agreement		
	1. There must be an offer		
	2. Offer must be accepted		

MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Production Technology (continued)	Related Knowledge (con't.) 3. Agreement must be voluntary B. Competent parties 1. Parties to agreement must be legally qualified 2. Insane persons, convicts, drunkards, minors are not regarded legally qualified C. Consideration 1. Must be present for contract to be binding 2. Consideration is something of value received by one party or given up by another D. Lawful act-within the law IV. Forms of a contract A. Verbal 1. Parties simply agree among themselves as to terms, conditions 2. Verbal contracts generally will not hold up in a court of law B. Written 1. Spells out all terms and considerations 2. Agreement signed and witnessed V. Types of contracts A. Fixed B. Cost plus fixed fee C. Cost plus percentage of cost D. Index E. General conditions	Define: Legally competent, Consideration, Lawful act Present: Examples to the class for discussion Discuss: Forms of a contract Passout: Sample contract Explain: Each type contract	Passout: (Teacher prepared)

MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Production Technology (continued)	Related Knowledge (con't.) F. Specifications VI. Contract format A. Cover B. Bid forms C. Instructions to bidder D. Index E. General conditions F. Specifications VII. Clauses to avoid VIII. Breach of contract A. Failure of one party to honor all terms of agreements B. Grounds for lawsuit 1. Plantiff - person instituting lawsuit 2. Defendant - person against whom action is brought IX. Penalties A. Damages and delays B. Performance bonds	Discussion of terms Analyze: Contract specifications Explain: Breach of contract; possible results Point Out: Value of cost estimating	

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MAJOR BLOCK XV THE BUSINESS OF ELECTRONICS	TASK: 3. Scheduling AIM: The student will be able to read and interpret a bar chart production schedule, and given the proper input, prepare a bar chart for a project.

MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Production Technology	Related Knowledge I. Definition A. A plan of timed events B. A systematic procedure takes into account 1. Job sequence 2. Timetable 3. Machines required II. Purpose A. Prevents costly mistakes B. Promotes efficiency III. Prerequisites for designing a good production schedule A. Experience in all phases of production processes B. Knowledgeable of the people who will perform the work C. Experience in estimating IV. Steps in making a simple production schedule A. List jobs to be performed in vertical column 1. In logic sequence 2. Include delivery dates of materials; equipment 3. Some jobs may parallel B. List horizontally across top, total estimate 1. Hours 2. Days 3. Weeks 4. Months	Reading assignment Explain procedure for making a bar chart Illustrate on chalkboard	

MINOR BLOCK C	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Production Technology (continued)	Related Knowledge (con't.) C. Criss-cross lines to form a chart and hang on wall D. Color - in time schedule; each job (yellow) 1. On horizontal bar of job 2. Under appropriate dates within total time schedule E. Cross-hatch estimated percent of each job as job progresses V. Read construction schedule A. Stretch horizontal wire above/below dates B. Hang vertical weighted ribbon from horizontal wire C. Slide ribbon along wire each day D. Read job in appropriate horizontal column to: 1. See where production should be 2. Compare actual production with time 3. Plan manpower a. Number of employees b. Type skills required VI. Other types of production schedule charts A. Critical path method B. Gantt chart method	Discuss with class Demonstrate Pass out hypothetical bar chart Oral questions Show examples of other production schedules Review Test	Pass out (Teacher prepared)

MAJOR BLOCK XV THE BUSINESS OF ELECTRONICS	TASK: 1. Hiring AIM: The student will be able to prepare a personal resume and write an appropriate letter of application. The student will be able to list and knowledgeably discuss commonly used practices and procedures in recruiting and hiring personnel.		
MINOR BLOCK D	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Personnel Technology	Related Knowledge		
	I. Major practices in hiring personnel	Reading assignment	Sup. Ref. C
	A. Recruitment - finding and attracting potential employees		
	B. Selection - screening to find best qualified	Lecture practices in hiring	
	C. Induction - program designed to make new employees feel they belong		
	II. Techniques of recruitment	List techniques of recruitment	
	A. Advertisement		
	1. By word-of-mouth		
	2. On-the-site-advertisement		
	3. Newspaper and trade journals		
	B. School and college placement centers		
	C. Employment agencies		
	1. Public		
	2. Private		
	D. Trade unions		
	III. Selection processes		
	A. Letters of application	Pass out: Sample letter of application	
	1. Contents	Discuss: Contents; organization	
	2. Organization	Students write letter	
	B. Application forms	Pass out sample application form	
	1. Includes personal data		
	2. Provides references		
	3. Reveals work experience		

MINOR BLOCK D	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Personnel Technology (continued)	Related Knowledge (con't.) C. Resumes, dossiers, and portfolios 1. Perform similar function as application form 2. May include sample of applicant's work; especially engineering, drafting D. Tests 1. Proficiency tests - measure existing ability 2. Aptitude tests - measure ability to learn E. Personal interview 1. Generally considered most important part of hiring process 2. Allows person hiring to judge intangibles (value judgements) a. Optimism b. Sincerity c. Whether applicant will fit into family of employees 3. Gives applicant opportunity to ask about the job; the company IV. Induction procedure A. Designed to make new employee feel he/she belongs B. Program, informal or formal, provides employee with: 1. Company history, its products	Discuss with class Point out intangible items best judged via personal confrontation List items on chalkboard	

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MINOR BLOCK D	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Personnel Technology (continued)	Related Knowledge (con't.) 2. Employee benefits; services 3. Employee duties; work rules; practices 4. Company structure; opportunities for advancement; importance of each job to whole operation V. Holding personnel A. Employer-employee relations 1. Fairness 2. Dignity of individuals 3. Mutual respect B. Work conditions 1. Environment (physical conditions) 2. Safety a. Equipment b. Procedures C. Salaries; wages D. Incentives (fringe benefits) 1. Sick leave 2. Vacations 3. Insurance plans	Encourage class participation Discuss employer-employee relations; Students prepare questions for mock interviews Mock interviews of classmates before class Class critique	

MAJOR BLOCK XV THE BUSINESS OF ELECTRONICS	TASK: 2. Internal Relations AIM: The student will be able to list many personal qualities employers seek in potential employees and reasons for each. The student will further be able to describe conditions of employment desirable by potential employees and reasons for such.		
MINOR BLOCK D	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Personnel Technology	Related Knowledge I. Company organization A. How structured 1. Divisions/departments 2. Positions/jobs B. Duties and responsibilities 1. Span of control 2. Limits of responsibility II. Policies and procedures III. Lines of authority A. Levels at which orders are given B. Levels at which advice is given IV. Line - staff relations A. Cause for reprimands 1. Doing something he/she shouldn't 2. Not doing something he/she should B. Causes for dismissal 1. Attitudes 2. Inefficiency V. Employee-employer relations A. What employer can expect from employees 1. Dependability a. Work hours b. Work standards c. Company policies 2. Productivity a. Efficient use of time	Reading assignment Lecture: Supplement with chalkboard illustrations Discuss: Lines of authority, line-staff relations Oral examples Brainstorming session by class List on chalkboard Recite examples of each	

MINOR BLOCK D	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Personnel Technology (continued)	Related Knowledge (con't.) b. Work attitudes c. Cooperation 3. Loyalty a. Become part of the organization b. Support and improve organization 4. Harmony a. Honesty b. Work with others B. What employees can expect from employer 1. Organization a. Planning b. Conducting 2. Communication a. What? where? when? b. Communication, two ways 3. Appreciation a. Policies fair, consistent b. Incentives c. Recognition C. Security 1. Training 2. Advancement 3. Retirement VI. Employee-employer relations A. Professional respect 1. Work attitudes 2. Cooperation 3. Job maturity B. Social respect 1. Others property 2. Dignity of individuals 3. Social amenities	List on chalkboard Discuss each as listed Review	

MAJOR BLOCK XV

THE BUSINESS OF ELECTRONICS

TASK: 3. Public Relations

AIM: The student will be able to explain the concept of public relations; the purpose of public relations, and the need for good public relations.

MINOR BLOCK D	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Personnel Technology	Related Knowledge		
	I. Definitions	Reading assignment	
	A. Public opinion		
	B. Communication specialists		
	C. Public relations		
	II. Purpose of public relations	Explain purpose and intent	
	A. Promote company's product/service		
	B. Develop a degree of knowledge about product		
	C. Establish policy of goodwill		
	III. Need for public relations		
	A. Inform the public		
	B. Influence public opinion		
	C. Interpret public wants		
	IV. Principles of public relations	List principles	
	A. Listening - to public opinion		
	B. Analyzing - objectives of company		
	C. Planning - programs of communication		
	D. Implementing - program to stimulate desired public attitude		
	V. Day-by-day practice of public relations	Discuss day-by-day practices	
	A. Business community		
	1. Reputation		
	2. Ethics		
	3. Product quality		
	B. Civic community		
	1. Contribution to community		

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MINOR BLOCK D	INFORMATION & TASK DETAIL	SUGGESTIONS FOR TEACHING	REFERENCES & AIDS
Personnel Technology (continued)	Related Knowledge (con't.) 2. Involvement in community C. Advertising 1. Advertising 2. Techniques	Guest speaker public relations	Speaker: P.R. Specialist

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Training Department
225 Main Street
Newington, Connecticut 06111

DEVELOPING A FUNCTIONAL COURSE OF STUDY

The vocational industrial teacher should carefully study the objectives of the local school, the objectives of vocational industrial education and the content that should be included in the vocational industrial course of study. The teacher should then select the content and write behavorial objectives which will have a definite relationship to the course. Each objective should be analyzed as to the activity which can be provided to promote its development. The objectives are then accepted or rejected on the basis of facilities available to place the activity into operation. (See Appendix page for a partial list of items that may be used in developing specific objectives for the development of abilities, attitudes and appreciations.)

When selecting the course content for a functional course of study, the vocational industrial teacher should carefully consider each of the following:

1. Provide for the development of skills in all basic processes inherent in the occupation involved.
2. Provide student experiences in the interpretation and use of fundamental factual information basic to the occupation and to the success of the student.
3. Provide experiences in related science, mathematics, blueprint reading and shop sketching and other subjects or topics related to the occupation.
4. Provide learning experiences regarding hazards, benefits, joys, and sorrows connected with a chosen occupation.
5. Provide experiences which will enable students to take their place in life and fulfill their life's needs as an an enlightened citizen and worker.
6. Provide learning experiences whereby students are enabled to see their prospective occupation in relationship to management, labor and the professions.

PROFESSIONAL SERVICES

Texas local school administrators and local school supervisors may obtain the services of area consultants, vocational industrial teacher educators and vocational industrial personnel of Vocational Industrial Services to assist the teacher with the development of the complete course of study. This professional service is available on written request to the Associate Commissioner for Occupational Education, Texas Education Agency, Austin, Texas 78711.

A SUGGESTED LIST OF ITEMS THAT SHOULD BE INCLUDED IN WRITING SPECIFIC OBJECTIVES FOR THE DEVELOPMENT OF ABILITIES, DESIRABLE ATTITUDES, AND APPRECIATIONS

Related technical information
Basic manipulative tasks
Good work habits
Good safety habits
Problem solving
Administering first aid
Make working sketches
Make good use of library
Ability to communicate
Ability to talk effectively
Leadership skills
Reading skills
Understand everyday science
The value of other courses
Basic economics, business & management
State & national issues, related to occupation
Keeping up to date
Civic needs of the community
Adapt to changes in technology
Relate work to manpower situation
Pride in a job well done
Live harmoniously with others
Broad aspects of work-trends-factors
Professional trade associations
Goals of vocational & technical education
Social Security and benefits
Free enterprise system
Techniques of job application
Recognize hazards and remove them
True meaning of loyalty to trade and to self

Open-minded and receptive to change
A sense of balance and proportion
A high quality of workmanship
Needs of others
A willingness to do more than minimum
Workmanship having recognized value
Respect for authority
Rise above failure
Overcome boredom
Value of time
Speak up in defense of principles
A willingness to accept assignment
Reliability-dependability to deliver
Value of experience
Value of speed in production
Value of the tools of the trade
Clean-safe work areas
Ability to plan work effectively
Employee-employer relations
Understand the democratic society
Individual initiative and responsibility
Values of moral conduct and ethical living
Our standard of living
Important people in this field
Mass production
Legislation (related)
History of the industry
Conservation
Listening effectively

ACTIVITIES SHOULD BE PROVIDED TO PROMOTE THE DEVELOPMENT OF EACH ITEM

METHOD	DESCRIPTION	ADVANTAGES	DISADVANTAGES	WHEN TO USE
1. LECTURE	Transferring information verbally. An explanation of the teaching points of each topic	Ability to handle large groups Ability to utilize radio Easy to provide facilities	Limits type of subjects Limits chance to learn Liable to confuse learner Can't measure efficiency	To impart new information To supplement other methods
2. ILLUSTRATION	Use of pictures, charts, maps, sketches, models, films, chalkboard	Brings out hidden features Learn by seeing Good substitution for demonstration Cheaper than demonstration	Sometimes hard to get Doesn't always teach what you want Eliminates teaching for doing ability	Profitable supplement to any other method As a substitute for demonstration
3. DEMONSTRATION	Actually doing the job step by step, explaining the how and why of each step	Builds confidence in instructor Proves information reliable More nearly affords complete learning	Lack of suitable place Lack of suitable equipment Excessive cost Takes time Limits size of class	Instructing for doing ability To supplement other methods
4. CONFERENCE	Drawing information from group and through discussion arrive at conclusion	Uses group experience Brings out best point of experience for new ideas Every man has chance	Experience of group Lack of trained leaders Conference may get out of control Takes a lot of time	Instructing for improved practices To reach conclusions Supplement to other methods
5. QUESTIONS & ANSWERS	Key questions planned by instructor on subject matter of lesson --tie-in with other lessons -- review of previous lesson -- application of lesson	To promote thinking To review Emphasize key points To promote individual participation Helps in developing understanding	Requires time and thought on part of instructor to select and frame good questions Sometimes used to kill time May allow some students to do all the talking if not properly directed	To review & tie-in preceding lesson Before concluding a lesson to review and emphasize major points To bring in experience of class members use with all methods

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METHOD	DESCRIPTION	ADVANTAGES	DISADVANTAGES	WHEN TO USE
6. PRACTICE	If skill is to be developed Learner practices performance of skill under close supervision	Develops performance skill	Danger of improper supervision	After instructor demonstrates a doing job the learner should always practice doing the job under supervision of the instructor
7. DRILL	If information is to be understood Learner reviews and repeats main points of information or problem solving until he has it mastered and understands it.	Helps master and retain points of information	Danger of improper supervision	After the instructor has presented an informational lesson with proper teaching aids and explanation, the opportunity to discuss, review or use the information is provided